1985 AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF NIAGARA

September, 1986

Ministry of the Environment
Ontario

B.I. BOYKO, Director
West Central Region

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Ministry of the Environment
Air Quality Assessment
Technical Support Section
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INTRODUCTION

This report summarizes the results of air monitoring in the Regional Municipality of Niagara in 1985.

The Ministry of the Environment has conducted routine monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to determine if air quality objectives are being met and to observe trends in air pollution.

MONITORING NETWORK

The Ministry of the Environment operates a network of monitors in the Regional Municipality of Niagara in Niagara Falls, Fort Erie, Chippawa, Port Colborne, St. Catharines, Thorold, and Welland. The Air Pollution Index (API) is measured in St. Catharines and Niagara Falls. The API is used as a warning system to alert the public to elevated air pollution levels. It is derived from 24 hour average concentrations of sulphur dioxide and particulate matter measured at single monitoring stations in those cities. The combination of these two pollutants at high concentrations has been shown to be indicative of adverse health effects. Hourly concentrations of both pollutants are telemetered to a central computer facility in Toronto. The computer then calculates the index, a dimensionless number based on the following mathematical equations:

St. Catharines

$$API = 1.15\ (16.84\ COH + 138.4\ SO_2)^{.97}$$

Niagara Falls

$$API = 1.47\ (15.74\ COH + 131.7\ SO_2)^{.92}$$

where:
COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

Values below 32 are considered acceptable. At 32, known as the advisory level and with a forecast of continued

unfavorable conditions, significant industrial sources may be asked to voluntarily curtail operations. At an API of 50, major emitters would be ordered by law to curtail some operations. At 75, further cutbacks would be required and at 100, all sources not essential to the public health and safety could be ordered to cease operations.

Meteorological data (wind and temperature) are measured near Allanburg. Figure 1 illustrates the wind frequency distribution for the area and shows that winds from the southwest quadrant predominate almost 40% of the time. Consequently, wherever possible, stations are normally located "downwind" of suspected pollution sources with respect to these southwest winds.

Wind data were utilized in a computer program known as a "pollution rose" - essentially a cross-tabulation of average hourly pollutant concentrations with wind direction. The data from this program are illustrated on various maps in this report and are a useful tool in determining the impact of any given source on a monitoring station. The length of each line of the "rose" is proportional to the average yearly concentration when the wind was blowing from that direction.

POLLUTANTS MONITORED

Two basic types of air pollutants are measured-gases and particulates (dust).

a) Gases measured with continuous analyzers include:

- Sulphur Dioxide (SO_2) - mostly monitored near industrial sources but SO_2 is also a product of domestic space heating. Air quality criteria and their underlying limiting factors are:

  1-hour average - .25 ppm (vegetation effects)
  24-hour average - .10 ppm (health effects in conjunction with particulates)
  1-year average - .02 ppm (vegetation effects)

- Total Reduced Sulphur (TRS) - measured exclusively near industrial sources. The measurement includes hydrogen sulphide (H_2S), the "rotten egg" gas but also other sulphur compounds. There are no general criteria for TRS but a one-hour criterion of 20 ppb exists for H_2S (given below). However, H_2S can actually be smelled at 10 ppb or less.

  1-hour average - 20 ppb (odour)

- Carbon-Monoxide-(CO) - measured for general ambient levels in St. Catharines. The major source of CO is the automobile. Criteria for CO are:

  1-hour average - 30 ppm (health effects)
  8-hour average - 13 ppm (health effects)

- Ozone (O_3) - measured in St. Catharines to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight and ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual and daily trends with highest levels occurring during the summer, and daily maxima usually occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distances and can be augmented by local sources. Most of the high levels measured in Southern Ontario each summer arrive from the United States. An objective for ozone is:

  1-hour average - 80 ppb (vegetation effects)

- Oxides of Nitrogen - general ambient levels were measured in St. Catharines. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Criteria exist only for NO_2:

  1-hour average - .20 ppm (odour)
  24-hour average - .10 ppm (health effects)

b) Particulates (dust) are measured by three methods, each relating to a different size range of particles.

- Dustfall - heavy material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere by gravity.

A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. Criteria are:

1-month average	- 7.0 g/m^2/30 days	(nuisance effects)
1-year average	- 4.5 g/m^2/30 days	(nuisance) effects)

- Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24 hour period. The exposed filter is weighed and the weight of solids collected is converted to an equivalent concentration in air. Units used are micrograms per cubic metre. The samplers run once every six days. Criteria based on health effects in conjunction with sulphur dioxide are:

24-hour average	- 120 ug/m^3	(health effects)
1-year geometric mean	- 60 ug/m^3	(health effects)

- Soiling Index (Coefficient of Haze) - measured by tape samplers which measure fine particles less than 10 microns. Industrial sources as well as general ambient air are monitored. Coefficient of haze tape samplers determine hourly soiling values. Air is drawn through a filter paper tape for one hour. A

beam of light is shone through the paper before and after the airborne particles are collected. The difference in light transmission is translated into a coefficient of haze (COH) unit. The paper tape then advances and a new hourly sample is collected. The criteria shown below are based largely on correlations with total suspended particulate (TSP).

24-hour average - 1.0 COH's/1000 linear feet of air
1 year average - .5 " " " " " " "

DATA ANALYSIS

Fort Erie

Sulphur dioxide was measured just outside Fort Erie on the shore of Lake Erie at station 27048, Niagara Public Works. The monitor was placed there in 1977 in response to concerns that SO_2 from the Nanticoke Industrial area was impacting the Buffalo area. However, levels have been very low with all criteria met as shown in Table 1. The pollution rose in Figure 13 indicates that highest averages occurred with north, southwest and southeast winds, from areas in the United States. The Nanticoke area had little effect on the readings. Since all previous data had indicated likewise, the monitor was removed in October 1985.

Niagara Falls

The Air Pollution Index (API) Station (27056) on Allendale Avenue, near the Falls tourist area reached a maximum API of 19 on April 24, still well below the advisory level. Elevated pollutant levels were widespread on this day as the Hamilton API was also elevated (the St. Catharines API was unavailable). Normally however, the API was very low, averaging only 4 for the year.

Sulphur dioxide and soiling index concentrations at the Allendale Avenue station 27056 given in Tables 1 and 3 were generally low and met all objectives. Figures 2 and 5 show the yearly trends for these two parameters at the API station dating back to 1980. Little change in levels is evident.

The pollution rose given in Figure 14 for sulphur dioxide shows the highest average for east winds indicating the influence of the Niagara Falls, New York industrial area.

For soiling index in Figure 15, highest levels were from the southeast quadrant. This may indicate a small influence of the Norton Company in Chippawa located 3 km away. District abatement staff have begun an investigation into this company's emissions for the purpose of developing a control program (see Chippawa). Another potential source of fine particles from the southeast direction could be traffic in the Falls tourist area.

Suspended particulates (TSP) at API station 27056 were generally low and met the yearly objective (Table 7). One sample exceeded the daily objective on May 31 during a severe windstorm which caused elevated readings throughout the Region. The trend of TSP dating back to 1980 is given in Figure 9 and shows a gradual decline in levels since that time to well below the yearly objective. It is possible that this decline is partly related to the move from 27049 to 27056 in 1983.

Station 27055 at Stanley St., Niagara Falls, 500 metres northeast of General Abrasive Ltd., completed its second full year of monitoring in 1985. This station contains SO_2 and TRS analyzers, soiling index tape sampler and a hi-vol. The data for SO_2 and TRS is given in Tables 1 and 2 and show mostly low levels. All objectives for sulphur dioxide were met (Table 1). In the case of TRS, there were 10 hours in which the objective for hydrogen sulphide was exceeded (Table 2), compared to 4 in 1984. The pollution roses in Figures 16 and 17 indicate that General Abrasives is the primary source of both pollutants as both roses show peaks under south-southwest winds. For sulphur dioxide, some importation from the U.S. from the east-southeast is also evident.

The hi-vol at station 27055 (Stanley St.) measuring suspended particulates showed a worse situation as the yearly mean was high at 79 ug/m^3 (Table 7). However, this was still a definite improvement from 1984, when a mean of 103 was recorded. Additionally, only 18% of the samples exceeded the daily objective of 120 ug/m^3, compared to 44% in 1984. The improvement may be partly attributable to the completion of nearby construction at the Niagara Falls sewage treatment plant which had been ongoing throughout 1984. Some minor problems with dust collection equipment at General Abrasives that were corrected during 1985 could also have influenced the TSP data.

The soiling index tape sampler at 27055 (Stanley St.) which measures much finer particles than the hi-vol showed much lower concentrations (Table 3) within criteria - the daily objective was not exceeded. The pollution rose in Figure 18 indicates little contribution of fine particles from General Abrasive under southwest winds. Fallout from this plant would appear to consist primarily of larger particles affecting a very localized area. The greatest impact on station 27055 soiling index as shown in Figure 18, is from the southeast, ie., likely from Cyanamid (to be discussed below). General Abrasive has been the subject of a survey during 1986 by Abatement Staff. An emissions control program should be in place early in 1987 to address the particulate and hydrogen sulphide emissions.

Suspended particulates were also measured at Station 27053 at First and Bridge, 500 metres southeast of Cyanamid. The data in Table 7 show that the annual geometric mean was reduced by 12% from 1984 and only 5 samples out of 57 exceeded the daily objective. Suspended particulate concentrations were reduced at all Niagara Region stations in 1985 (Table 7), consequently, it is possible that the improvements were

either weather related or due to less importation of "background" from distant sources. There were no major abatement programs undertaken at industries that would appear to account for the reduction.

Highest levels at 27053 (First and Bridge) best correlated with northwest winds (although weakly) indicating the influence of Cyanamid. However, the station was not ideally located because northwest winds did not occur frequently (see Figure 1). In 1986, the monitor was returned to a location downwind of the prevailing southwesterlies.

As mentioned, the soiling index sampler at station 27055 northwest of the plant also seemed to show an impact from Cyanamid (Figure 18). A preliminary survey of Cyanamid suggests there are operational rather than design defects contributing to particulate emissions. The company's operation is under investigation and a program to address all emissions problems will be developed over the next year.

Chippawa

Station 27051 at Norton and Portage, 200 metres northeast of the Norton Company indicated that air quality problems near the plant still exist despite the installation of a tall stack in 1982. The station contains SO_2 and TRS analyzers. Hi-vol and dustfall measurements were also made in the area.

SO_2 and TRS data are summarized in Tables 1 and 2. Although all SO_2 objectives were met (Table 1) , the one-hour objective for hydrogen sulphide was exceeded 71 times during the year (Table 2). The trend graphs in Figures 3 and 4, however, do show that the sulphur dioxide hourly objective has not been exceeded since 1982, and that TRS exceedences of

20 ppb have decreased dramatically since 1982. The installation of the tall stack previously mentioned is largely responsible for this improvement.

Pollution roses in Figures 19 and 20 clearly indicate the contribution of the Norton plant as both SO_2 and TRS roses show peaks under southwest winds. Both roses also show lesser importations from the northeast, from across the Niagara River.

Suspended particulate concentrations were measured at Station 27009 on Portage Road, which is close to the main station 27051. The yearly mean was only 64 ug/m^3, marginally exceeding the yearly objective, and 4 samples out of 47 exceeded the daily objective (Table 7). Each exceedence occurred on southwest wind days. As mentioned previously, the improvement was common to the Region. The trend graph in Figure 10 shows the huge improvements in TSP levels recorded at 27009, dating back to 1974 due to various emission control improvements made at this plant.

The background hi-vol 27014 located 2 km southwest at Stanley and Chippawa showed low and acceptable levels. It was removed from service at the end of the year.

Dustfall near the Norton plant at 27005, Portage and Legion exceeded the monthly objective in 5 out of 11 samples (Table 9). The background jar (27006) at Bridgewater and Oliver recorded much lower and acceptable levels. Similar to TSP, dustfall levels at 27005 have improved greatly since the 1970s (Figure 12).

The Welland District office has advised Norton that emissions do not meet requirements and has requested an abatement action plan from the company which may form the basis of a Control Order. A detailed survey of the plant by Abatement staff is scheduled for late 1986.

Port Colborne

Two hi-vols measuring suspended particulates near INCO (27030 and 27047) both recorded generally low and acceptable concentrations, slightly lower than in 1984 (Table 7).

Station 27047 lies 350 metres north-northwest of the refinery, while 27030 lies 1 km northeast. The former recorded slightly higher levels on average, but both recorded 2 exceedences of the daily objective. For 27047, both occurred on northerly wind days, while for 27030 one incident occurred on a common northerly wind day to 27047 and the other during a severe windstorm on May 31. In short, INCO did not appear to be the source of the exceedences. The annual trend for 27030 is given in Figure 10 and shows mostly low, stable levels since 1974.

The samples were analyzed for nickel, and no excessive concentrations above the objective (2 ug/m^3) were observed at either station (Table 8). Similar to TSP, nickel concentrations were much lower than in 1984, but unlike TSP, nickel levels did correlate to a certain degree with winds from the refinery, indicating that INCO did have a small effect on the measurements.

It would appear that INCO's effect on air quality was fairly small and localized. However, past Phytotoxicology Section surveys have demonstrated nickel contamination of vegetation in the area well above guidelines. No formal abatement program is scheduled for 1985-86 although the company will be requested to tighten emission controls where possible. The soil in the vicinity of the plant is nickel contaminated from past practices rather than current operations, and some re-entrainment accounts for nickel deposition on vegetation.

St. Catharines

The API measured downtown at station 27037, North and Geneva, reached a maximum of 18 on December 6. It is suspected that had the station been operating on April 24, a slightly higher maximum would have been recorded then, similar to Niagara Falls. Elevated API's here are generally due to soiling index rather than sulphur dioxide and are probably due to local traffic emissions during poor dispersion conditions. Normally the index was very low, averaging only 5 for the year.

Concentrations of sulphur dioxide, soiling index, carbon monoxide and nitrogen dioxide remained mostly unchanged and met all objectives at the API station (Tables 1, 3, 5 and 6). Trends of these pollutants are illustrated in Figures 2, 5, 7 and 8 and show generally stable levels over the years, with the exception of carbon monoxide which has gradually declined since 1977 (Figure 7). This is likely due to improvements in vehicle emission control systems.

Ozone concentrations were slightly lower on average than in 1984 and showed only 19 hours above the objective similar to 1984 as shown in Table 4. The trend in yearly exceedences of this objective is illustrated in Figure 6. The variations in this graph are mainly weather related, varying with the temperatures and quantities of sunshine each summer. The higher levels usually occur concurrently with other areas in Southern Ontario, and normally occur during south or southwesterly winds, downwind of sources in the United States.

Pollution roses for SO_2, soiling index, CO and NO_2 (Figures 21-24) all show highest averages during southeast winds probably pointing toward heavily traveled Niagara Street only 75 metres away.

The rose for ozone (Figure 25) shows its highest levels under southwest winds. This peak is not as prominent as might be expected since even during the summer, southerly winds do not automatically yield high ozone. Specific meteorological conditions are necessary. As mentioned, most of the elevated ozone levels measured are probably a result of long range transport from the United States.

The hi-vol at the St. Catharines API station recorded acceptable suspended particulate concentrations in 1985 (Table 7), with only two exceedences of the daily objective. Annual trends at this station given in Figure 9 have been relatively stable over the years, fluctuating marginally above and below the annual objective.

Dustfall near the Aimco Foundry at the Plymouth Ave., station 27040 (Table 9) deteriorated as shown in Figure 11, and continued to show elevated concentrations above objectives in all months except one. The deterioration is unaccounted for. An extremely high May reading, probably due to the May 31 windstorm, underscores the importance of fugitive emissions here. A survey of the Aimco Foundry has been completed identifying a number of emission sources. The company has embarked on a voluntary abatement program which should be reflected in the air quality data for 1986. Target date for completion is early 1987.

Dustfall near the General Motors Foundry at Station 27041, Glendale and QEW, (Table 9) also increased, with 9 months exceeding the monthly objective. However, a nearby quarry is a potential contributor to the readings, and microscopic analyses of the samples did show that some samples were composed mostly of non-foundry materials, namely carbonates. The trend graph in Figure 11 shows mostly stable levels with

small fluctuations just above the yearly objective. At the request of the Welland District office, General Motors is developing a plan to replace a large, side take-off cupola which has been identified as the major contributor to particulate emissions. A schedule for this program will be developed during 1986.

Dustfall near Burnstein Castings at Station 27054, Catherine and Russel, showed four excessive loadings, all during February to May. From June to December, levels were much lower and acceptable (Table 9). A survey of the company has been carried out by Abatement staff and a number of problems have been identified. A report which may form the basis of a Control Order is under development, and will be completed in fall, 1986. A formal abatement program will be put in place immediately following.

Thorold

Sulphur dioxide measured at Station 27042, Niagara Falls Rd. and Ontario St., across from Ontario Paper Limited, showed a moderately higher (but acceptable) yearly average in 1985. A total of 14 hourly readings exceeded the hourly objective, and the daily objective was exceeded once (Table 1). The trend graph in Figure 3 displays the marked reduction in the number of exceedences of the hourly objective since 1983. The improvement was due to the installation of a scrubber on the company's acid plant in 1981. Some very high short duration emissions attributable to digester blows are still being observed, however, and the pollution rose in Figure 26 still indicates the influence of the paper mill.

Dustfall near the paper mill is given in Table 9. It shows that the yearly average at station 27042 was twice as high as at the background station 27043 at McAdam Park and sulphate

contents were almost 3 times as high. Seven samples exceeded the monthly objective at 27042. The trend graph in Figure 11 does show, though, that improvements have taken place during the 1980s. A Control Order, which will be served in 1986, includes provisions for further sulphur dioxide control over the next three years. Some operational deficiencies in the recovery furnace have been corrected which may result in improved dustfall loadings.

Station 27052 completed its second full year of monitoring. This station is 100 metres northeast of Exolon Ltd. on Queen Street and consists of a hi-vol, soiling index tape sampler and SO_2 and TRS analyzers. SO_2 and TRS data are summarized in Tables 1 and 2. TRS concentrations exceeded the hourly objective for hydrogen sulphide 376 times (Table 2), while SO_2 concentrations exceeded the hourly objective 69 times and the daily objective 4 times. The TRS events occurred year-round, but the SO_2 events all occurred during January to April. There were no such SO_2 events in 1984. The reasons for this change are not readily apparent, but are under investigation by Abatement staff.

The pollution roses in Figures 27 and 28 indicate the influence of Exolon as both peaked sharply under west and west-southwest winds.

Suspended particulates at station 27052 (Table 7) showed extremely high levels with a geometric mean of 106 ug/m^3 (down from 131 in 1984), and 32 out of 56 samples exceeded the daily objective. The high concentrations correlated well with southwest wind frequency, indicating that Exolon was the source.

The soiling index tape sampler at 27052 recorded low levels of fine particulate with no exceedences of the daily criterion (Table 3). The soiling index pollution rose in Figure 29 shows little impact from the plant. Particulate emissions from Exolon would seem to consist mostly of heavy material not measured by the tape sampler.

The Exolon Co. is well ahead of schedule on a Program Approval to modernize the furnace operation which should result in significant reductions in suspended particulates, sulphur dioxide and TRS. Monitoring in 1986 will measure the success of the Program. Ministry staff have identified some operational (materials handling) practices which are not acceptable and will be corrected during 1986.

Welland

Suspended particulate concentrations near Union Carbide at station 27045, Alberta and Devon, (Table 7) decreased somewhat from levels measured in 1984, similar to the other stations in the Niagara Region. The yearly geometric mean was well below the objective and only two samples exceeded the daily objective. The concentrations did not correlate well with winds from Union Carbide, indicating that the station is little affected by the plant. The trend graph in Figure 10 shows a stable trend since 1981.

Occasionally elevated carbon contents (Table 8) continued to occur, and these data correlated weakly with southerly wind frequency, indicating Union Carbide's small influence on the area. The coal storage piles of this plant have been identified as a source, as have some of the materials handling practices. The company is working on a voluntary program to correct the minor sources implicated in a 1985 survey report.

Dustfall in the area also decreased from 1984 as shown in Table 9. Highest levels were observed at the base of Alberta Street, at station 27035 near the coal piles. Five samples exceeded the monthly objective, but this was significantly improved from 1984 observations. The other two monitors (27025-Harriet St. and 27026-Chaffey St.) recorded much lower levels with three exceedences of the monthly objective between them. The trend graph in Figure 12 shows the significant improvements which have taken place since 1980, as a result of a number of abatement measures taken by Union Carbide. Further "fine-tuning" at the plant should substantially reduce or eliminate exceedences during 1987.

DISCUSSION

This report has identified several local air pollution concerns in the Regional Municipality of Niagara. All are currently under investigation with a view to implementing control programs. Some control programs are already underway.

Apart from these localized problems, general air quality as characterized by our API (Air Pollution Index) stations in Niagara Falls and St. Catharines was very good. The advisory index level of 32 has never been exceeded at either of the two stations and both normally showed very low index readings, averaging 4 and 5 during 1985. They rarely exceed 20.

In 1986, a new air quality data telemetry system is to be installed throughout the Province. This new system will permit all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto, allowing for data retrieval on a real-time basis. Currently, only the two API stations and the meteorological tower near Allanburg are telemetered to Toronto. The remainder of the stations require manual reading of strip charts for the data. This chart reading process causes delays in the availability of data amounting to several months. The new system will allow for immediate access to data, both in the Regional Office in Hamilton and in Toronto, and will also allow for remote control and maintenance of the instruments. All of this will result in a more efficient monitoring program.

The new telemetry system is being installed to facilitate a new expanded Air Quality Index (AQI). The AQI will be a function of six different pollutants, which will form up to

eight separate subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone will all be individually converted to the current scale of index numbers with the same advisory or alert levels of 32, 50, 75 and 100. Not all stations will measure all of the parameters, but the highest subindex and the pollutant causing it will be reported several times daily to the public. In the Niagara Region, the new AQI's will be reported for the existing St. Catharines and Niagara Falls API stations. The new system has potential to add more communities in the future. The intent of the new index is to better inform the people of Ontario of air quality in their local area.

FIGURE 1

WIND FREQUENCY DISTRIBUTION

NIAGARA AREA 1985

27011 - ALLANBURG

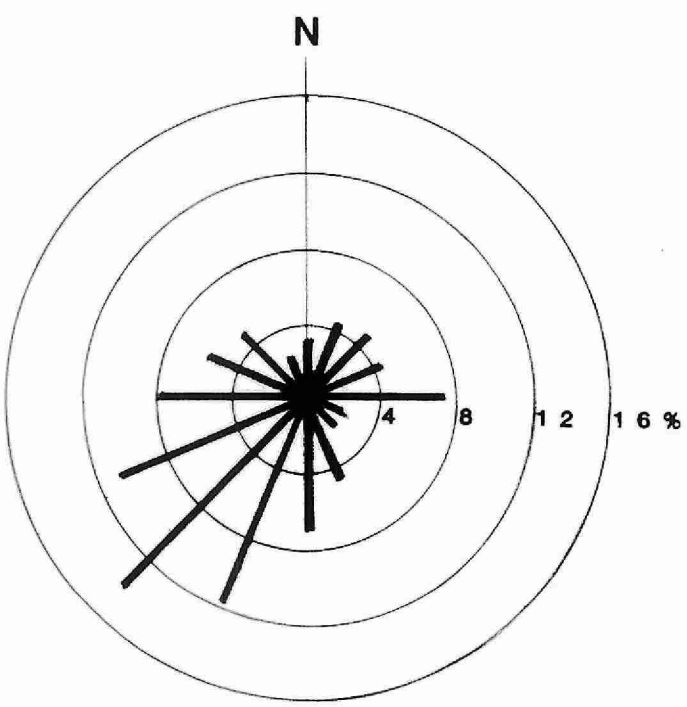


FIGURE 2

SULPHUR DIOXIDE YEARLY TREND

NIAGARA FALLS AND ST.CATHARINES

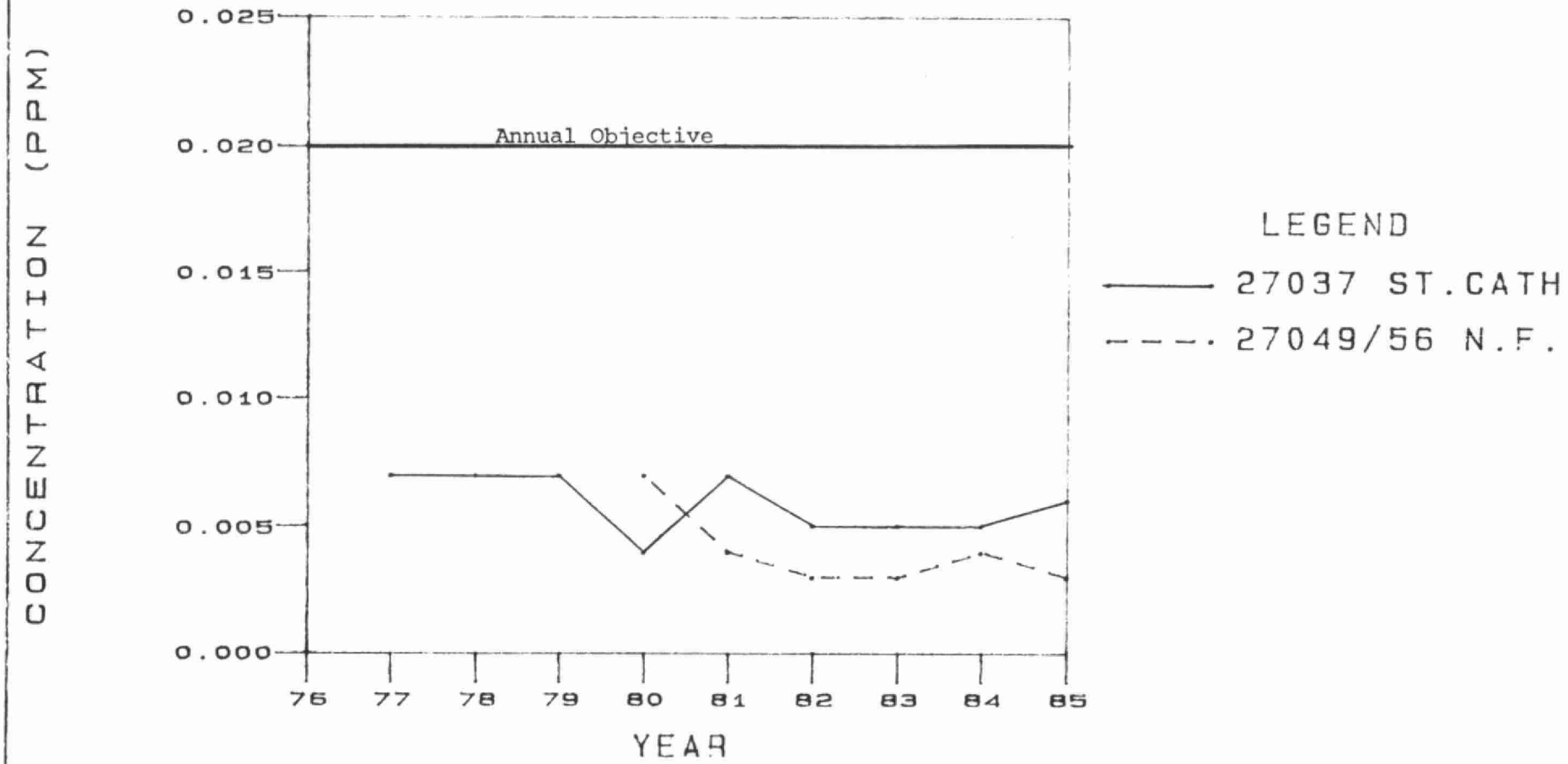
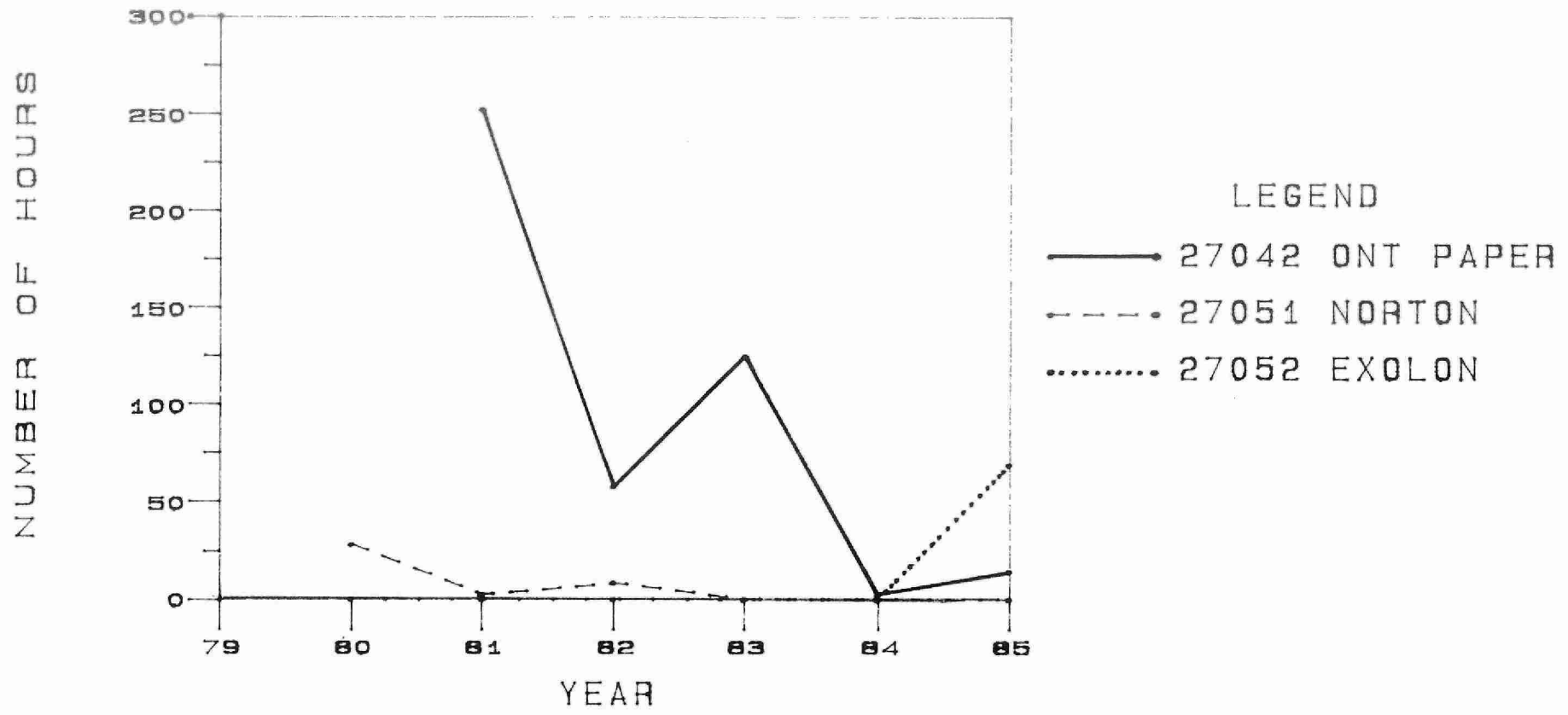


FIGURE 3

SO2 EXCEEDENCE TREND-NIAGARA INDUSTRY STATIONS

HOURS OVER .25 PPM



27055(GEN.ABRASIVE)-NO EXCEEDENCES IN 84/85

FIGURE 4

TRS EXCEEDENCE TREND-NIAGARA INDUSTRY STATIONS

HOURS OVER 20 PPB

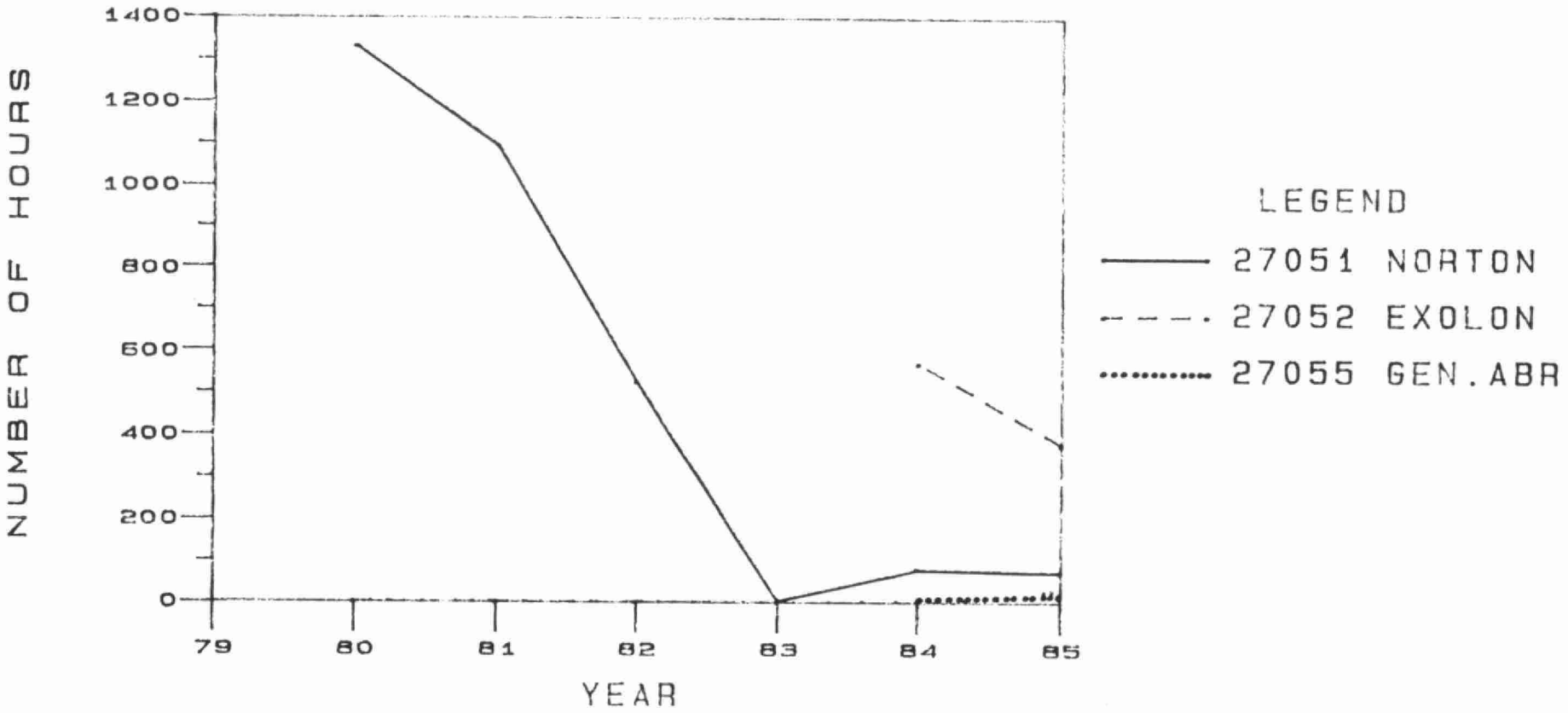


FIGURE 5

SOILING INDEX YEARLY TREND

NIAGARA FALLS AND ST.CATHARINES

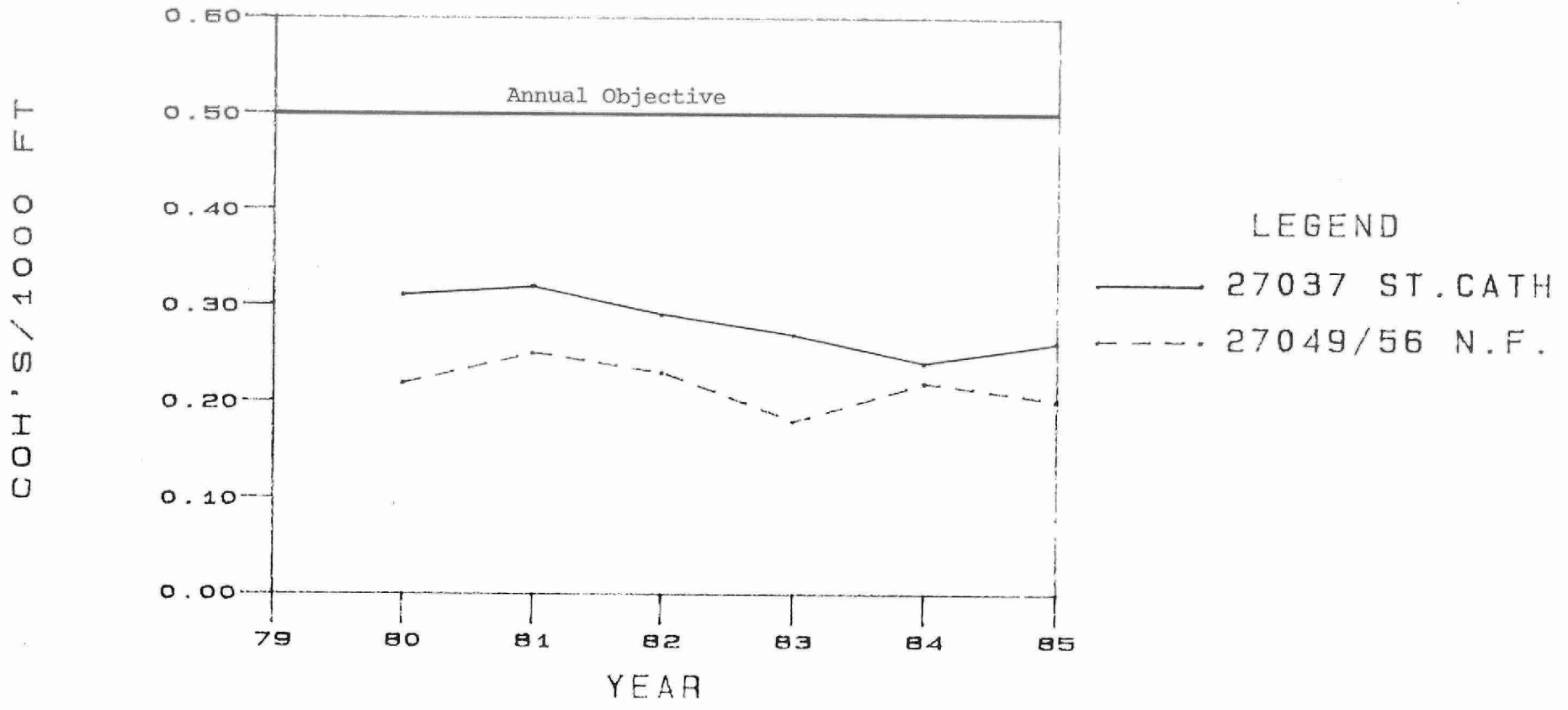


FIGURE 6

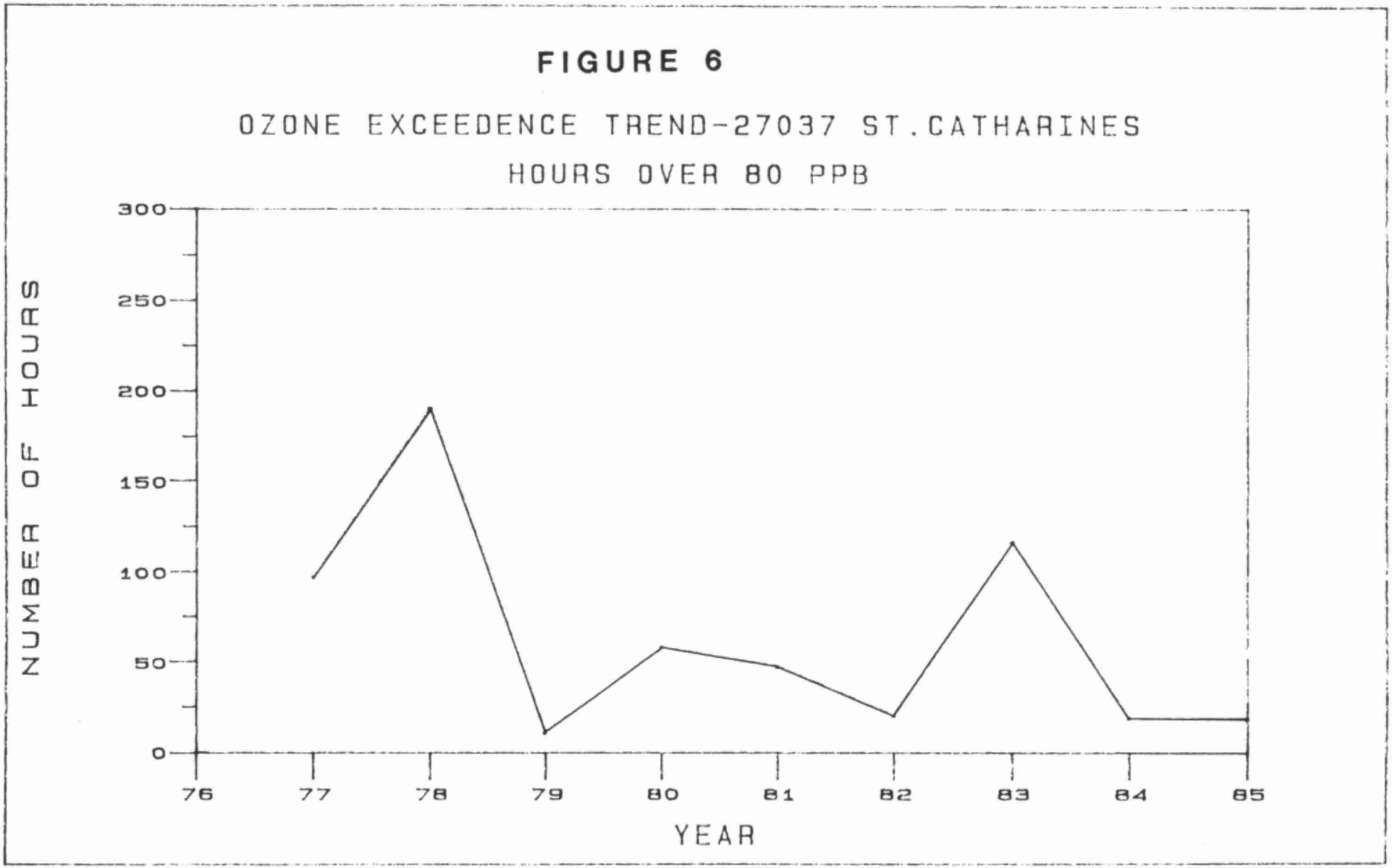

OZONE EXCEEDENCE TREND-27037 ST.CATHARINES
HOURS OVER 80 PPB
NUMBER OF HOURS
300
250
200
150
100
50
0
76
77
78
79
80
81
82
83
84
85
YEAR

FIGURE 7

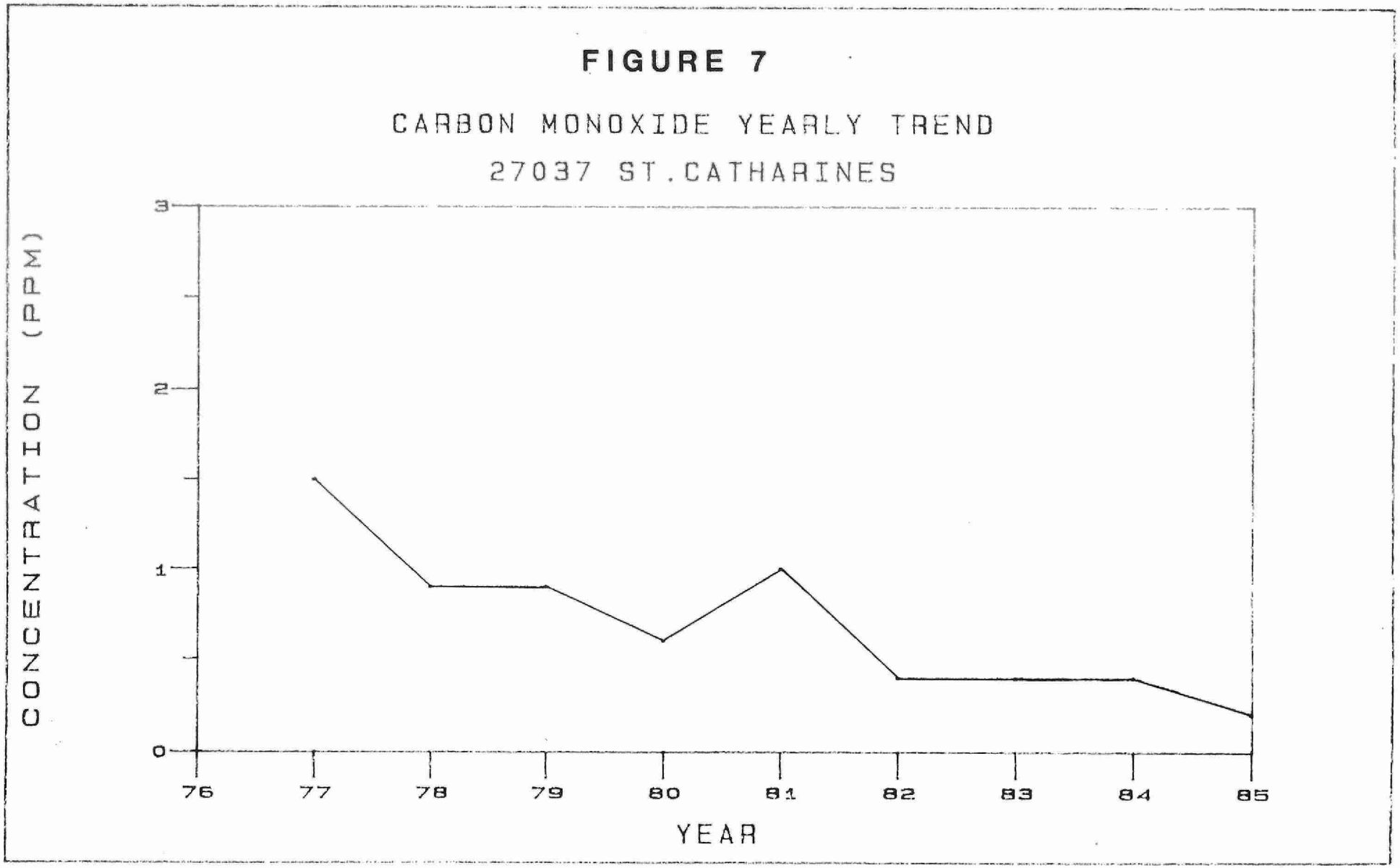

CARBON MONOXIDE YEARLY TREND
27037 ST.CATHARINES
CONCENTRATION (PPM)
3
2
1
0
76
77
78
79
80
81
82
83
84
85
YEAR

FIGURE 8

NITROGEN DIOXIDE YEARLY TREND

27037 ST.CATHARINES

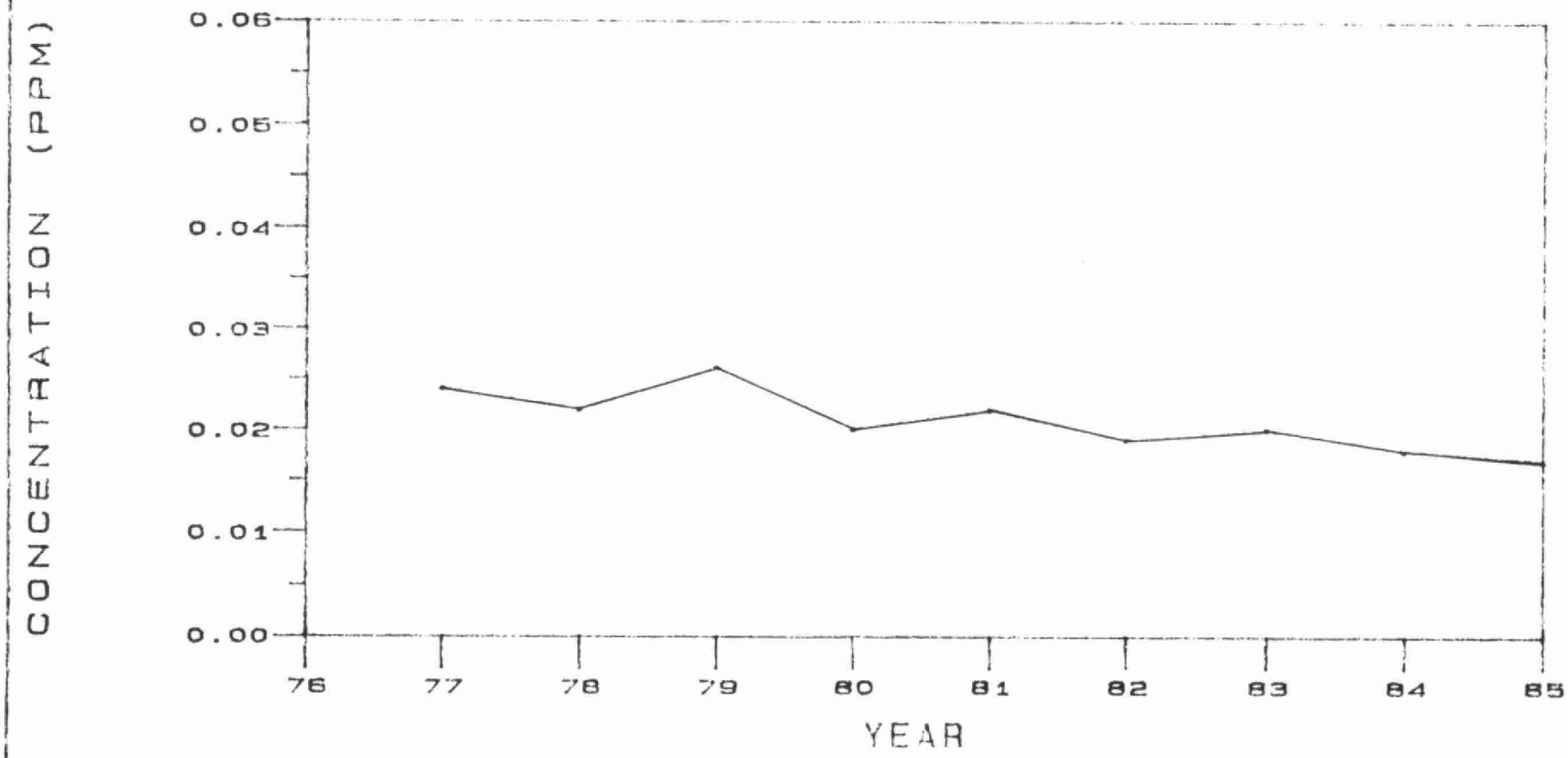


FIGURE 9

SUSPENDED PARTICULATES YEARLY TREND

ST.CATHARINES & NIAGARA FALLS

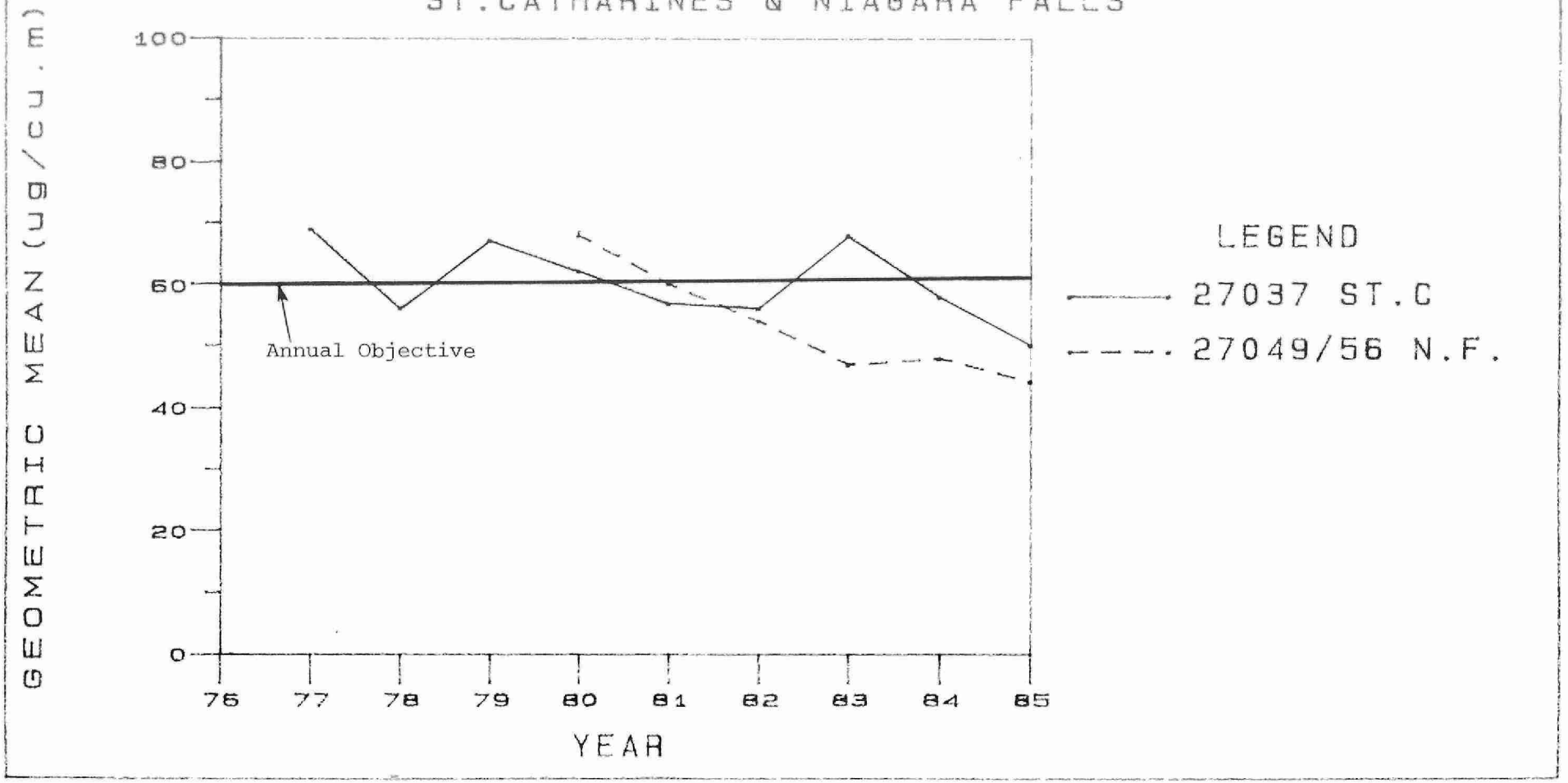


FIGURE 10

SUSPENDED PARTICULATES YEARLY TREND

NIAGARA AREA INDUSTRY STATIONS

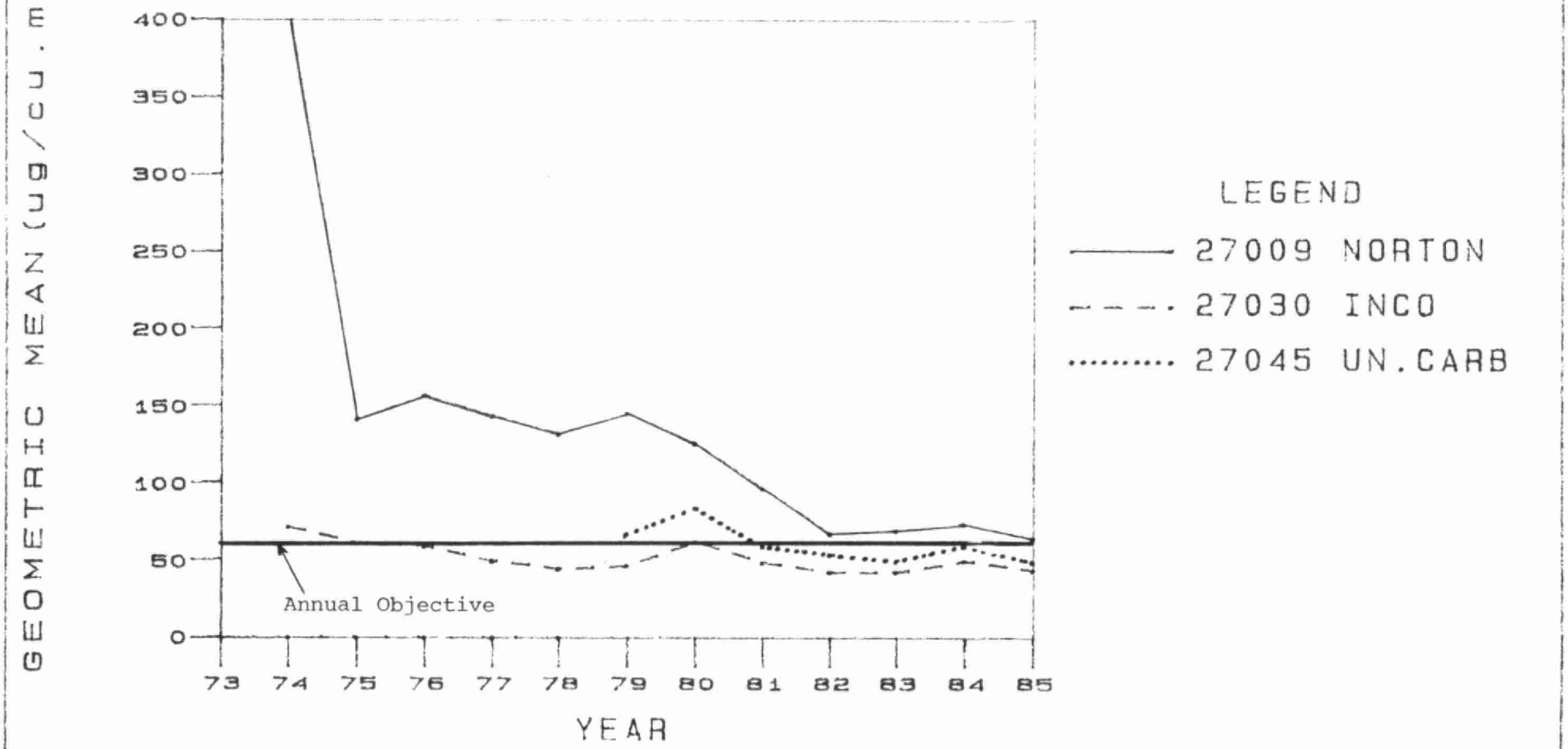


FIGURE 11

DUSTFALL YEARLY TREND

THOROLD & ST.CATHARINES INDUSTRY STATIONS

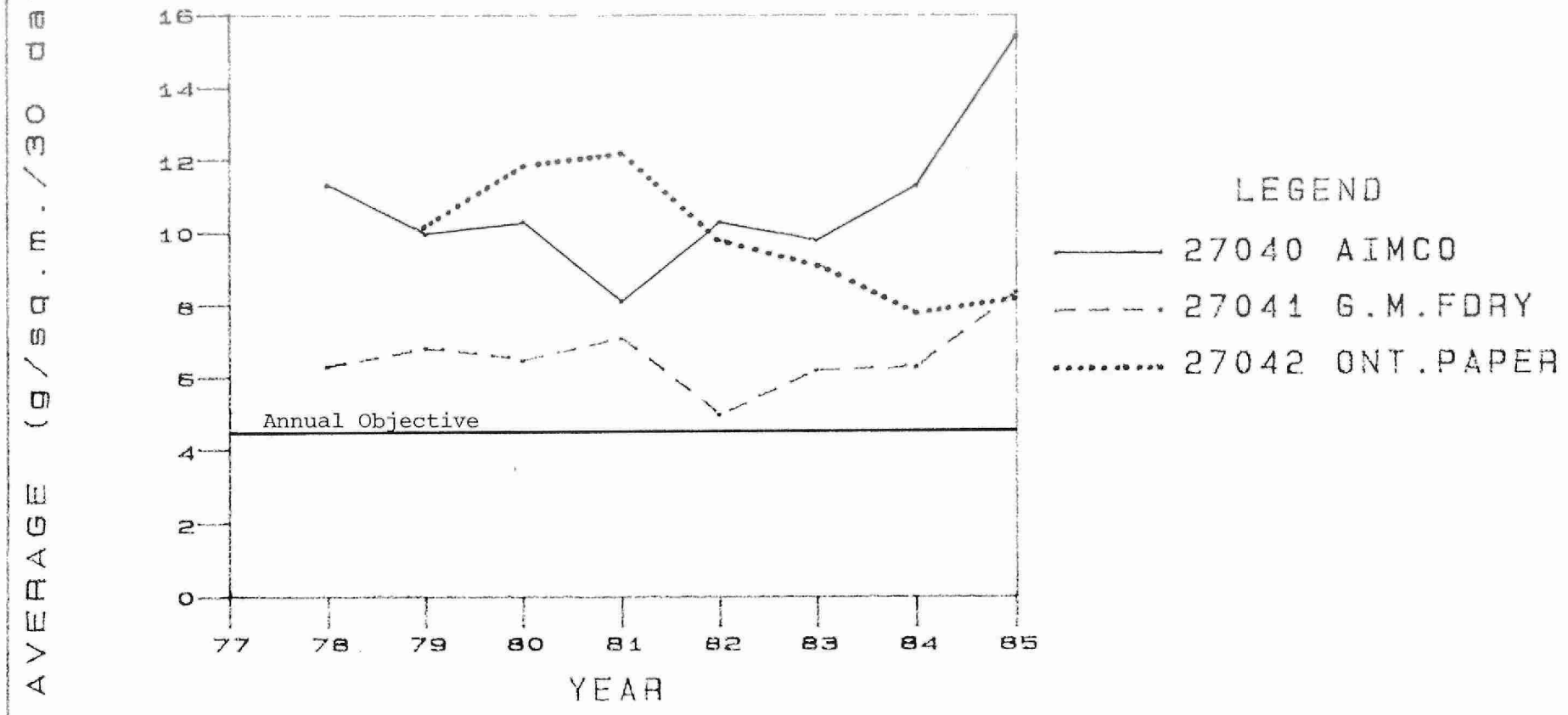
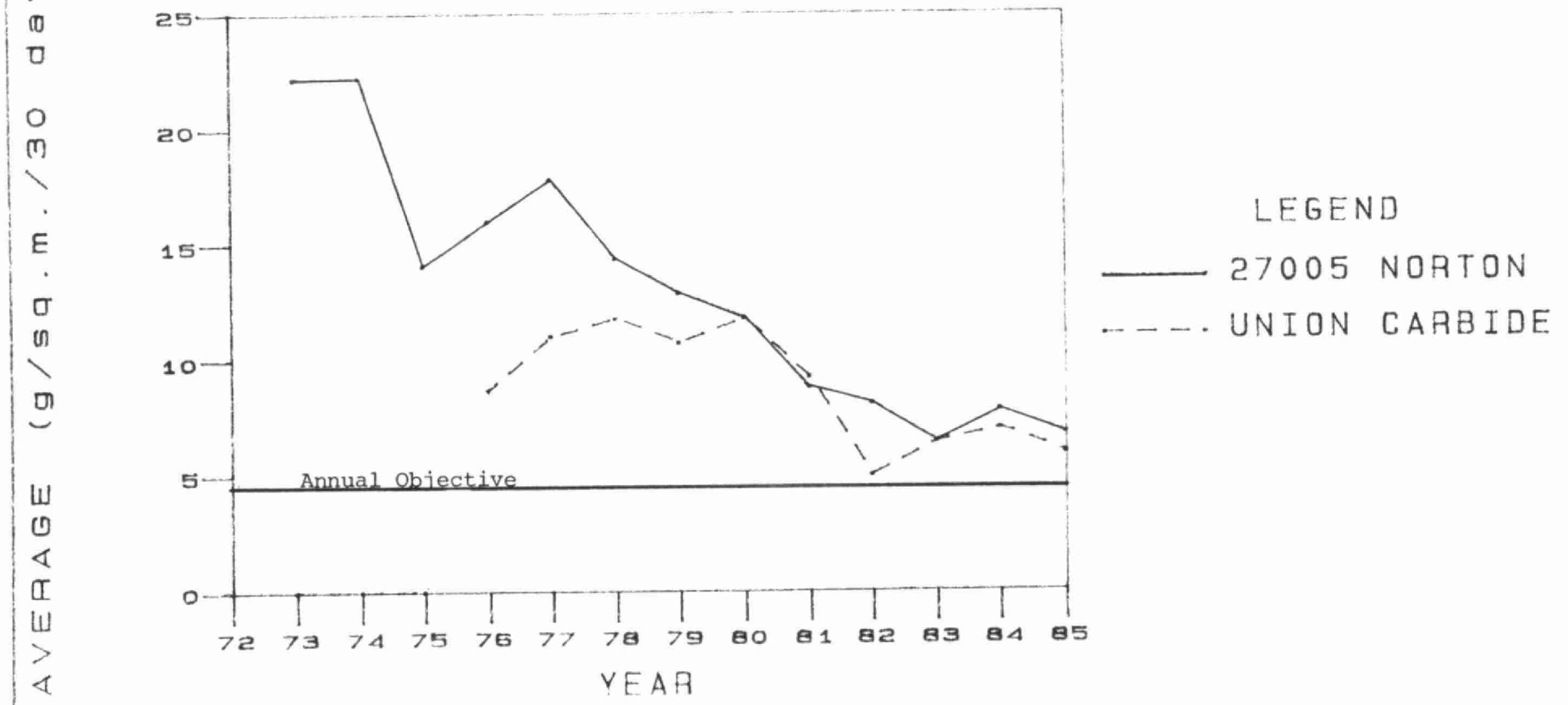


FIGURE 12

DUSTFALL YEARLY TREND

UNION CARBIDE (WELLAND) & NORTON (CHIPPAWA)



UNION CARBIDE TREND IS AVERAGE OF 3 STATIONS

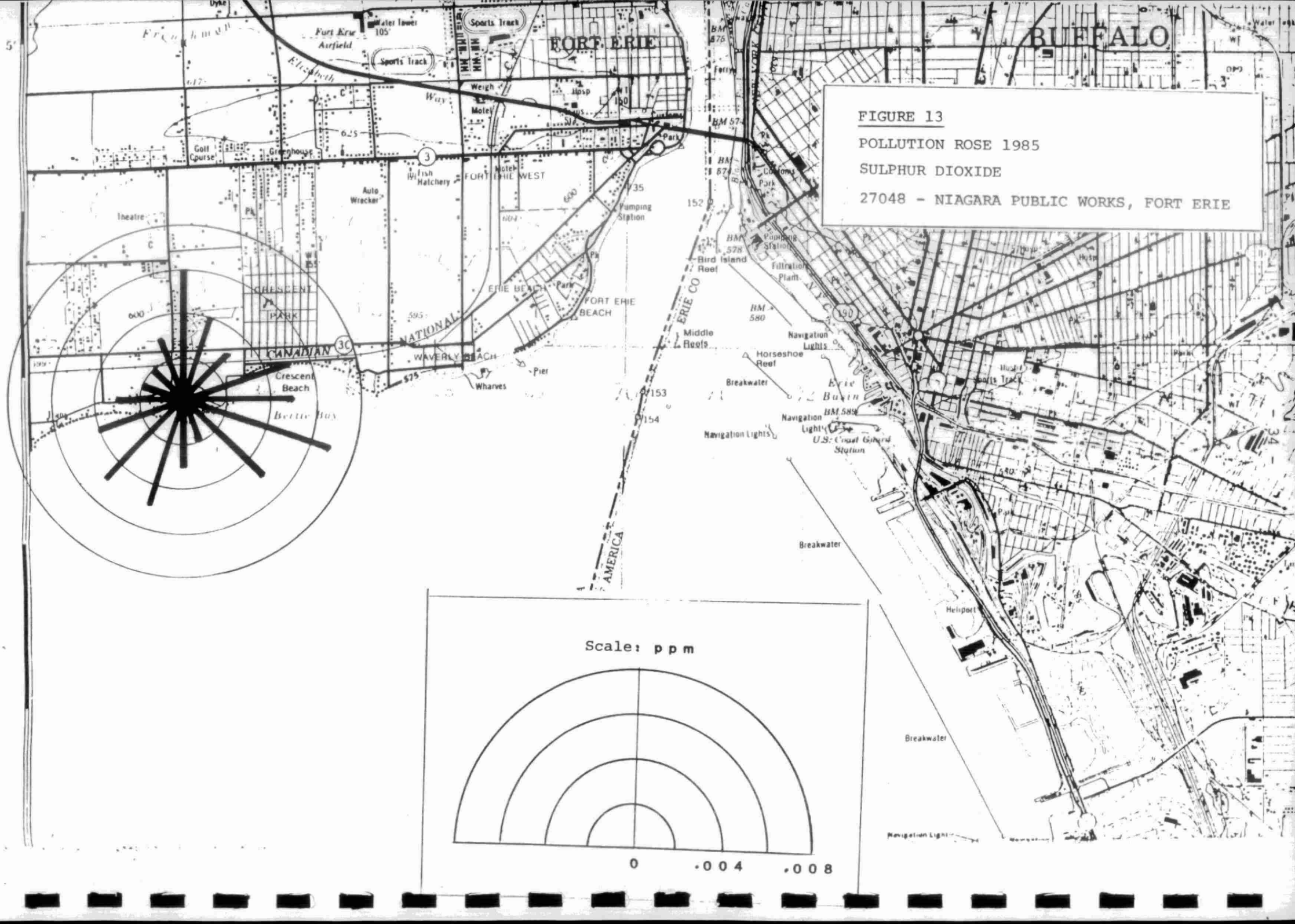


FIGURE 13
POLLUTION ROSE 1985
SULPHUR DIOXIDE
27048 - NIAGARA PUBLIC WORKS, FORT ERIE
FORT ERIE
BUFFALO
Scale: ppm
0
.004
.008

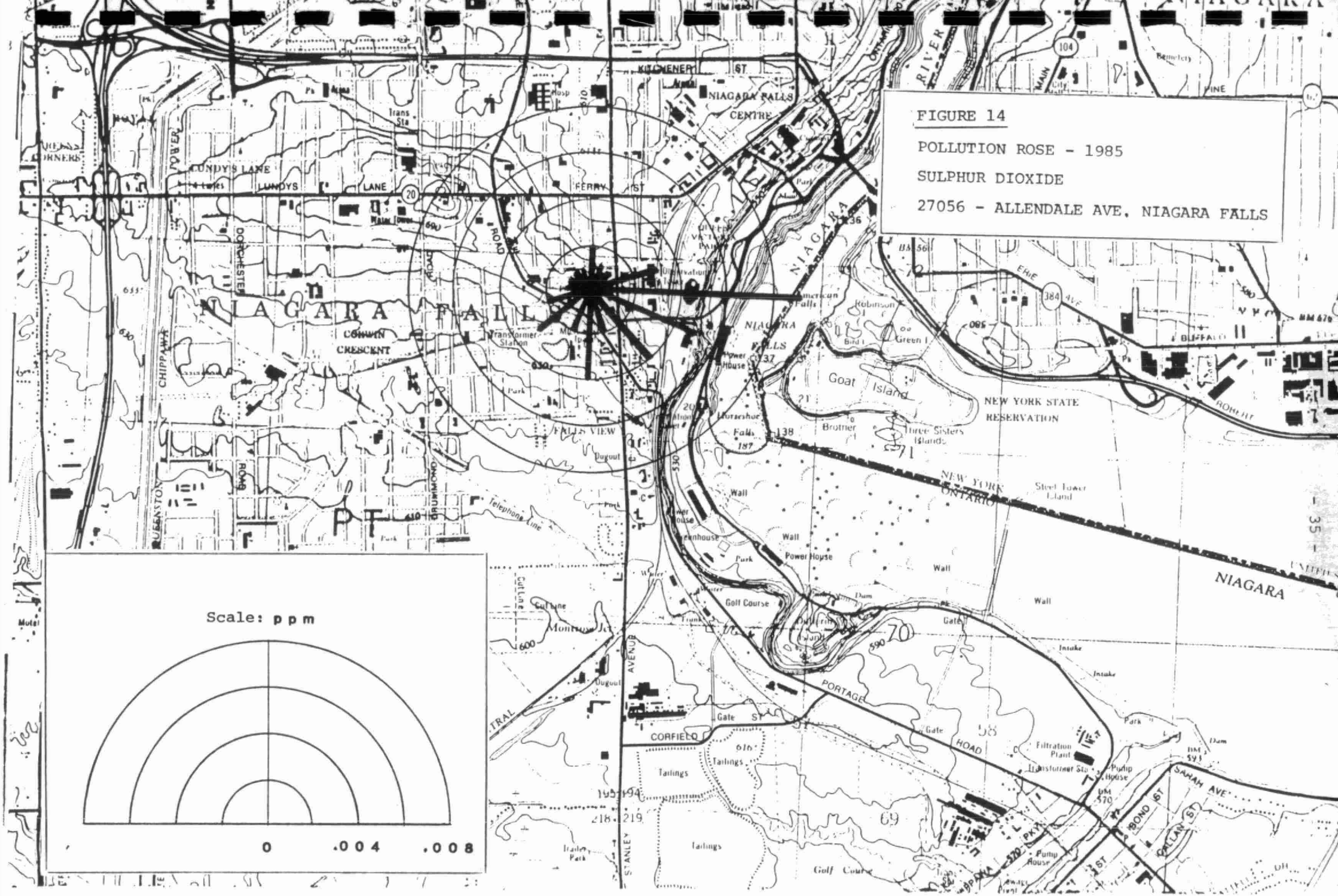


FIGURE 14

POLLUTION ROSE - 1985

SULPHUR DIOXIDE

27056 - ALLENDALE AVE, NIAGARA FALLS

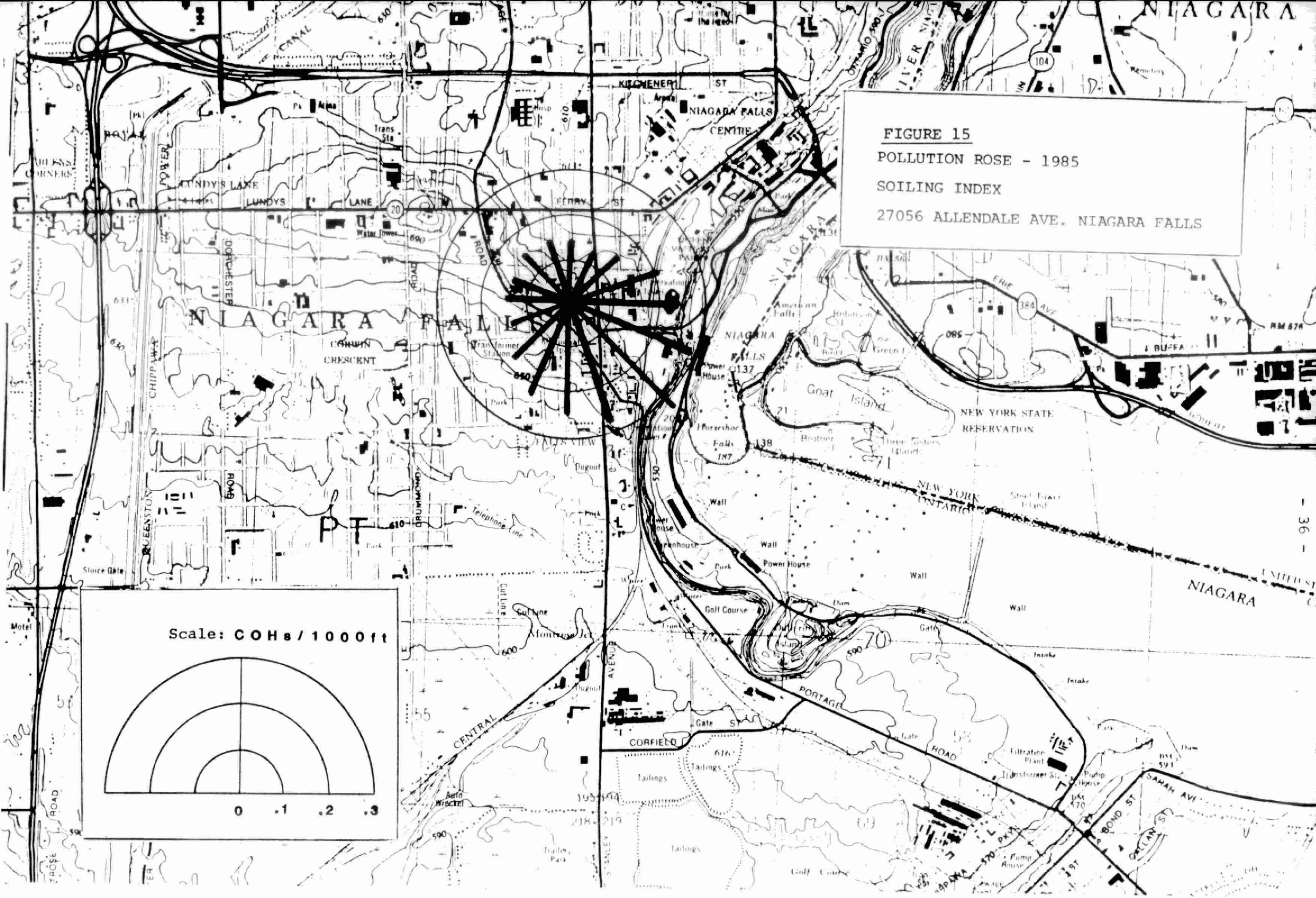


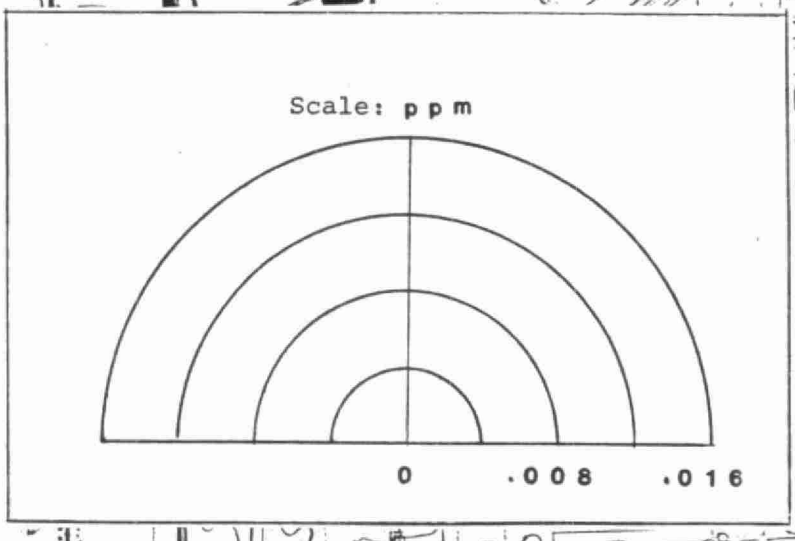
FIGURE 15
POLLUTION ROSE - 1985
SOILING INDEX
27056 ALLENDALE AVE. NIAGARA FALLS

FIGURE 16

POLLUTION ROSE - 1985

SULPHUR DIOXIDE

27055 - STANLEY AVE. NIAGARA FALLS.



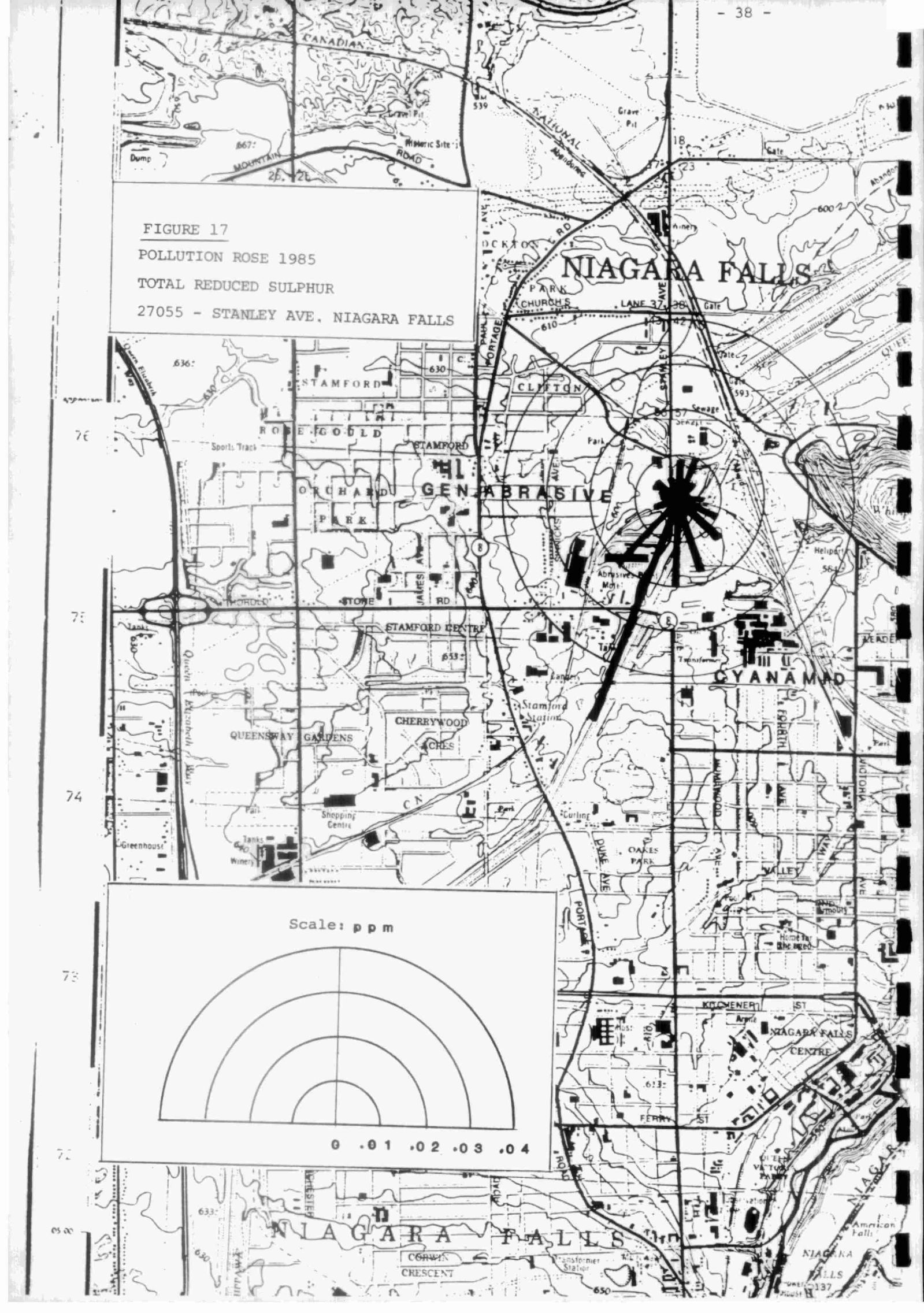


FIGURE 17
POLLUTION ROSE 1985
TOTAL REDUCED SULPHUR
27055 - STANLEY AVE. NIAGARA FALLS
Scale: ppm
0 .01 .02 .03 .04
NIAGARA FALLS
STAMFORD
CLIFTON
ROSE GOULD
ORCHARD PARK
GEN ABRASIVE
CYANAMID
STAMFORD CENTRE
QUEENSWAY GARDENS
CHERRYWOOD CRES
CANADIAN
MOUNTAIN ROAD
PORTAGE RD
STONE RD
KITCHENER ST
NIAGARA FALLS CENTRE
FERRY ST
CORWIN CRESCENT

FIGURE 18

POLLUTION ROSE - 1985

SOILING INDEX

27055 - STANLEY AVE, NIAGARA FALLS

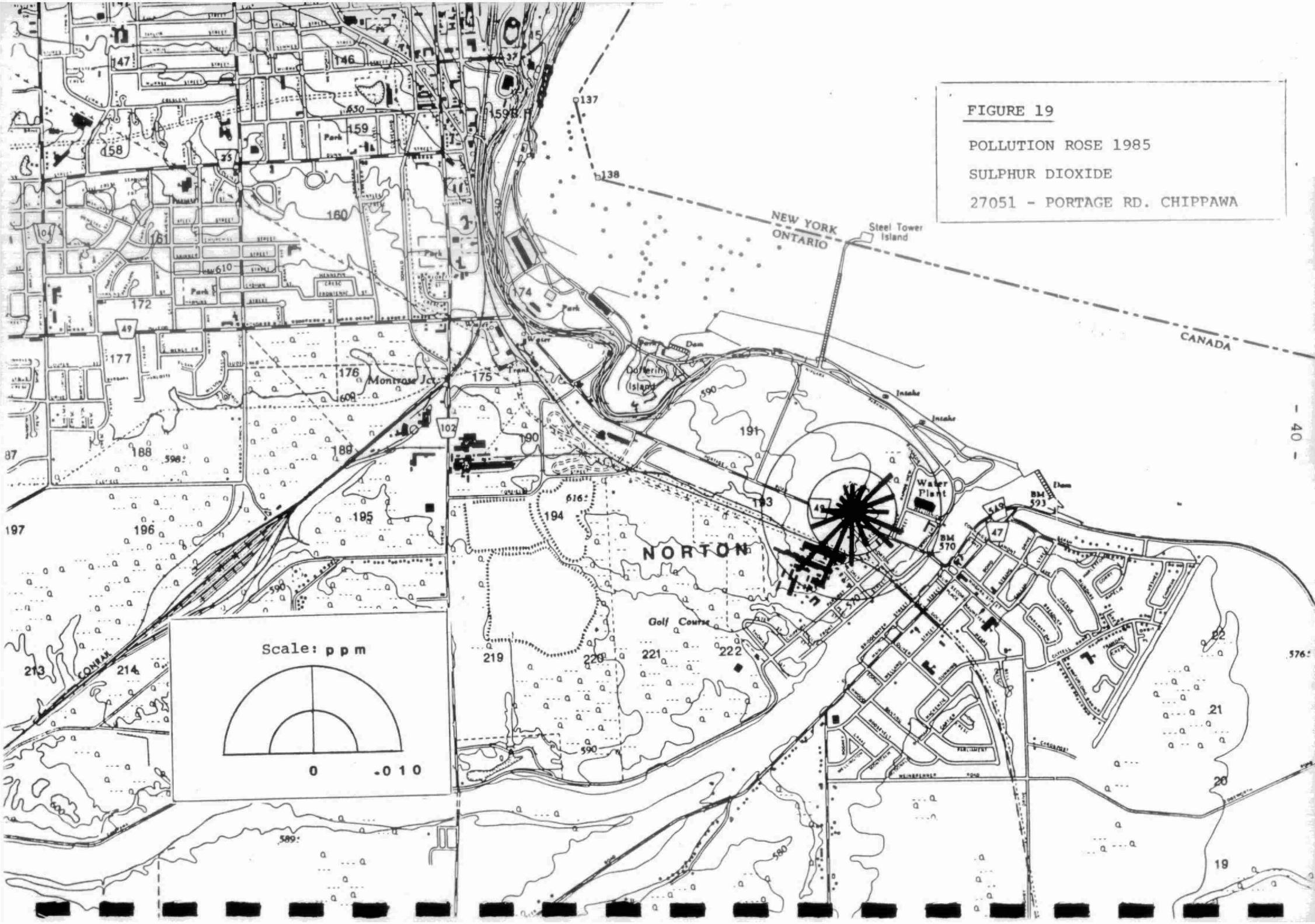


FIGURE 19
POLLUTION ROSE 1985
SULPHUR DIOXIDE
27051 - PORTAGE RD. CHIPPAWA
NEW YORK
ONTARIO
CANADA
Steel Tower
Island
Dufferin
Island
Water
Plant
Intake
Dam
Park
Golf Course
NORTON
Monroe Jct.
COMRAN
Scale: p p m
0
.010

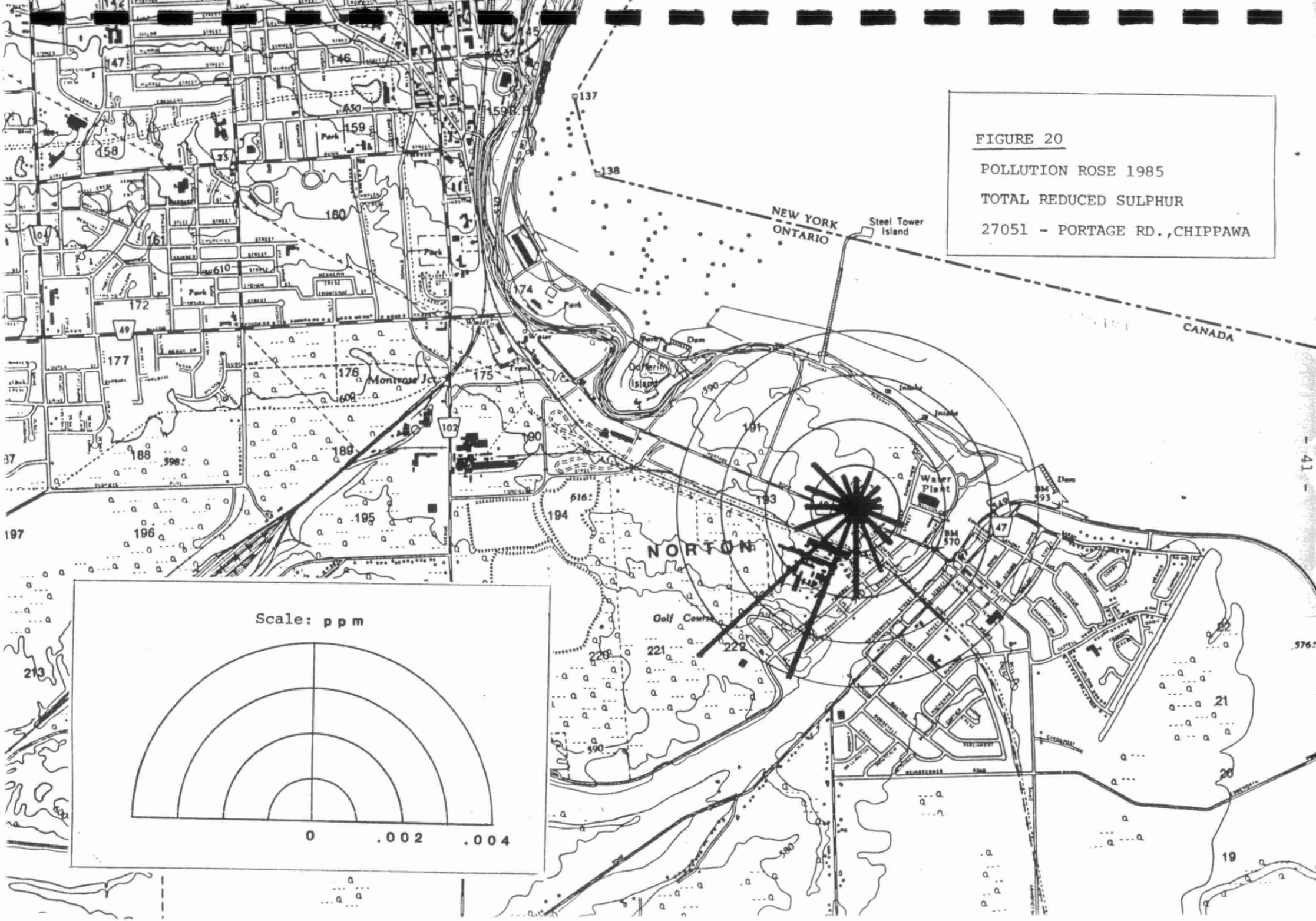


FIGURE 20
POLLUTION ROSE 1985
TOTAL REDUCED SULPHUR
27051 - PORTAGE RD.,CHIPPAWA
NEW YORK
ONTARIO
CANADA
Steel Tower
Island
Dufferin
Island
Montrose Jct.
NORTON
Water
Plant
Golf Course
Scale: ppm
0
.002
.004

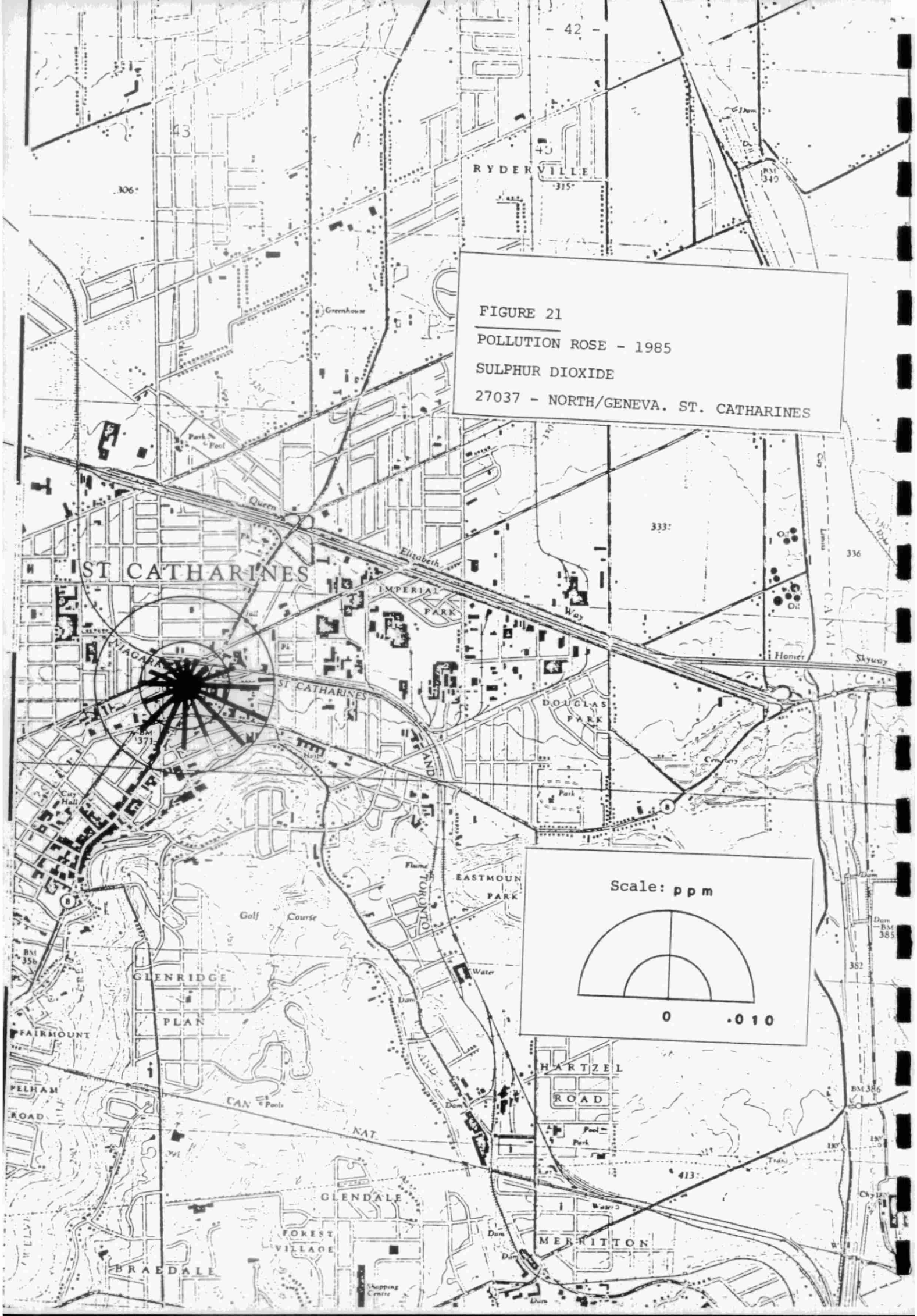


FIGURE 21

POLLUTION ROSE - 1985

SULPHUR DIOXIDE

27037 - NORTH/GENEVA. ST. CATHARINES

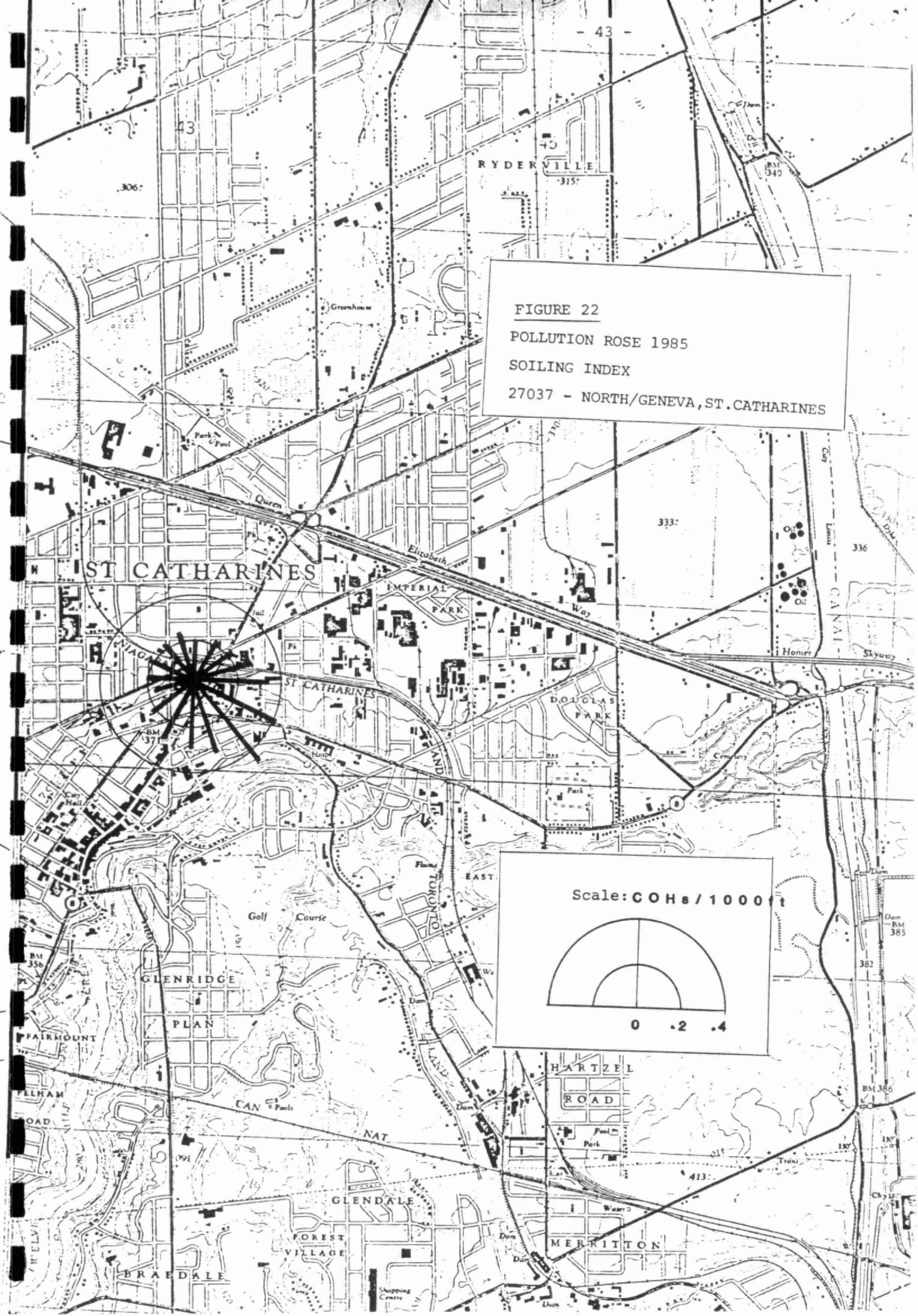


FIGURE 22

POLLUTION ROSE 1985

SOILING INDEX

27037 - NORTH/GENEVA, ST.CATHARINES

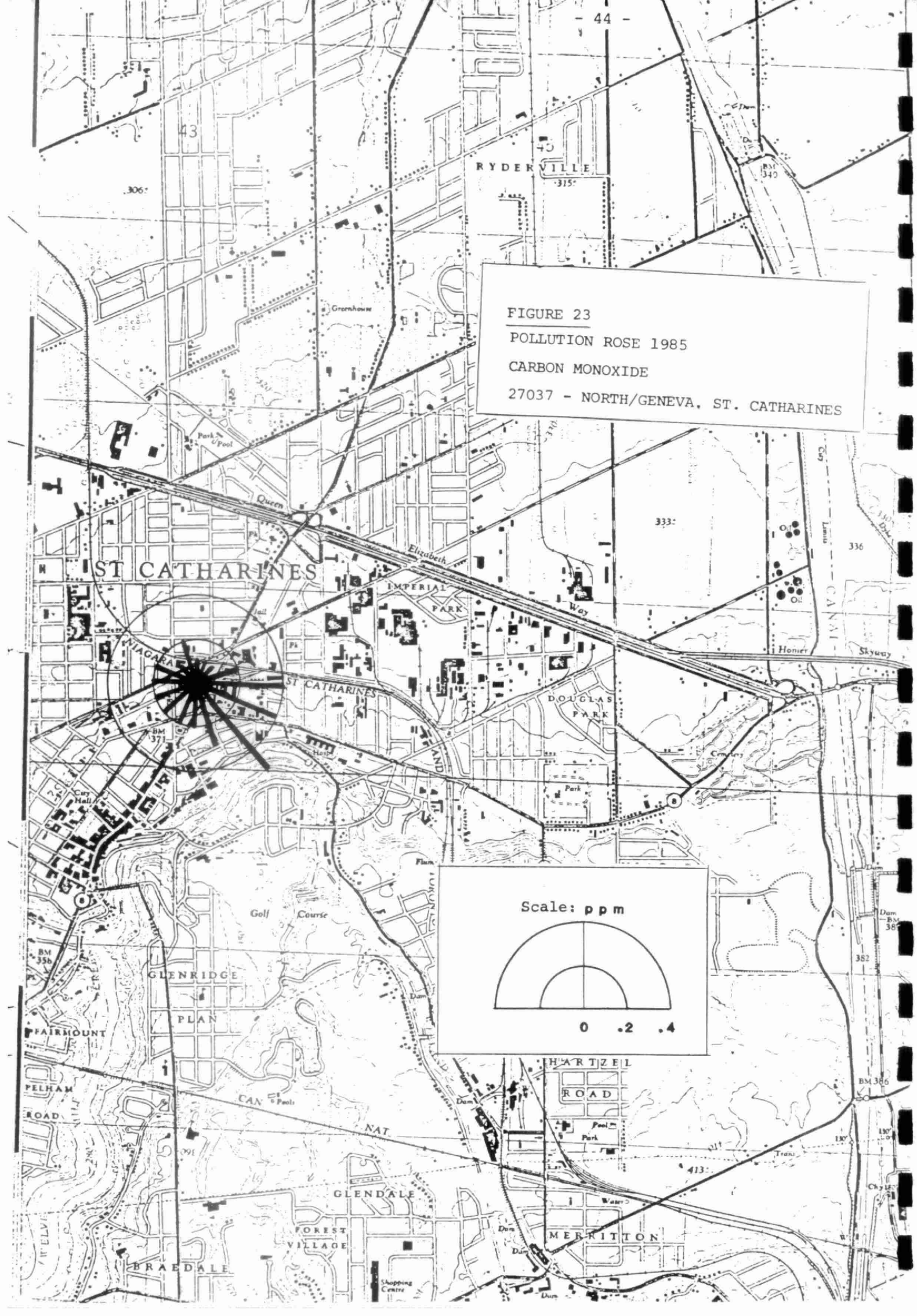


FIGURE 23

POLLUTION ROSE 1985

CARBON MONOXIDE

27037 - NORTH/GENEVA, ST. CATHARINES

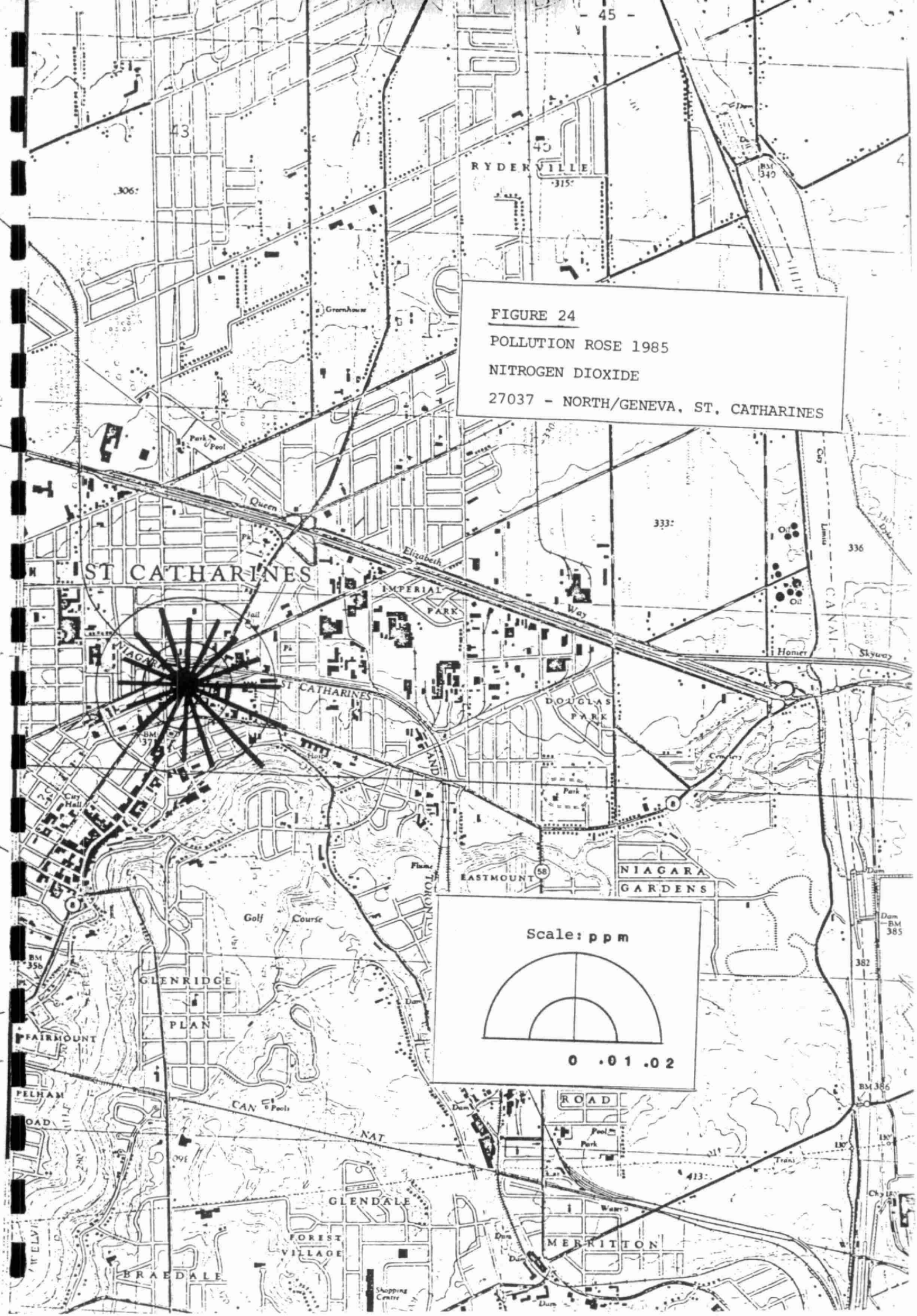


FIGURE 24

POLLUTION ROSE 1985

NITROGEN DIOXIDE

27037 - NORTH/GENEVA, ST. CATHARINES

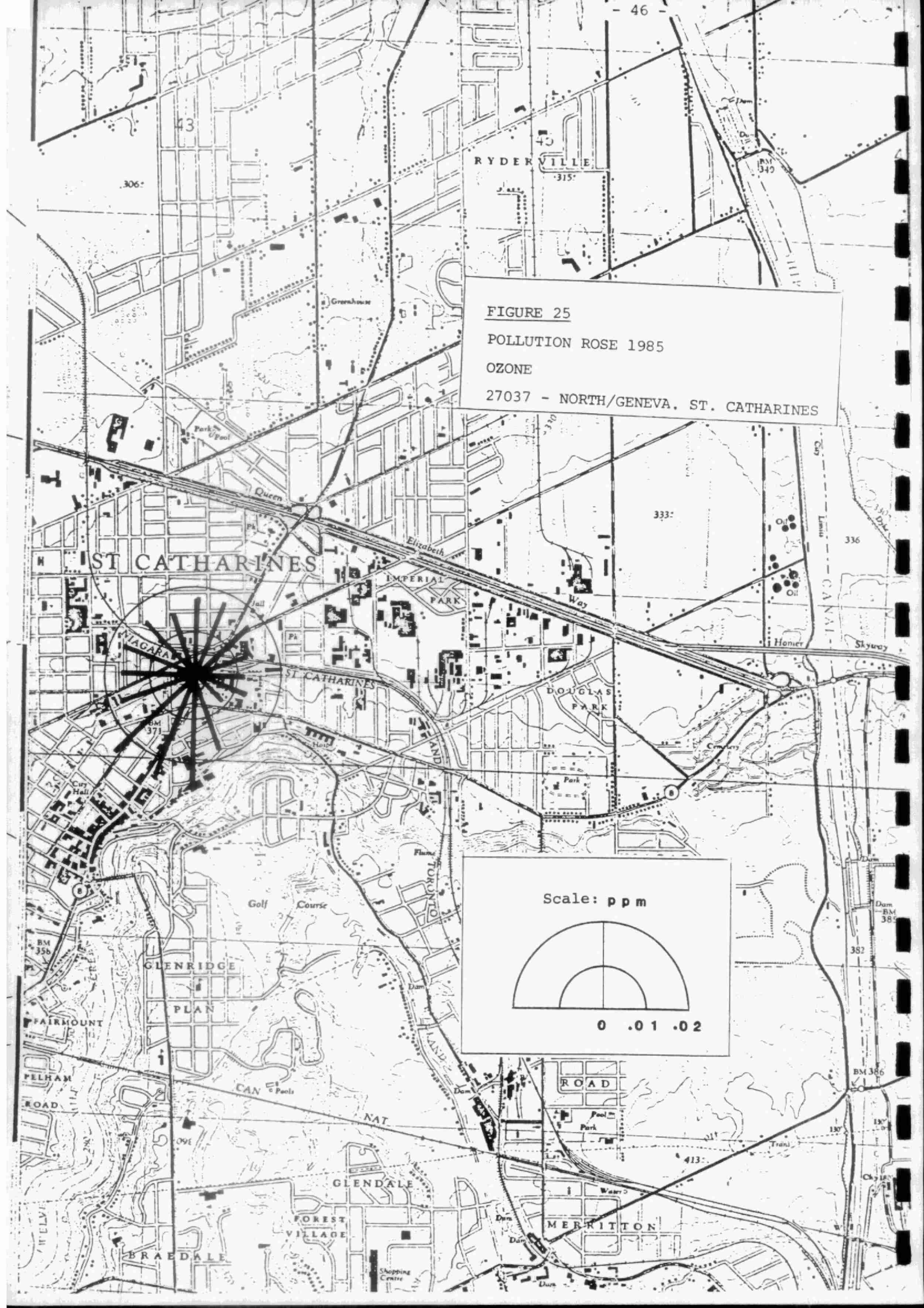


FIGURE 25

POLLUTION ROSE 1985

OZONE

27037 - NORTH/GENEVA. ST. CATHARINES

CANADA

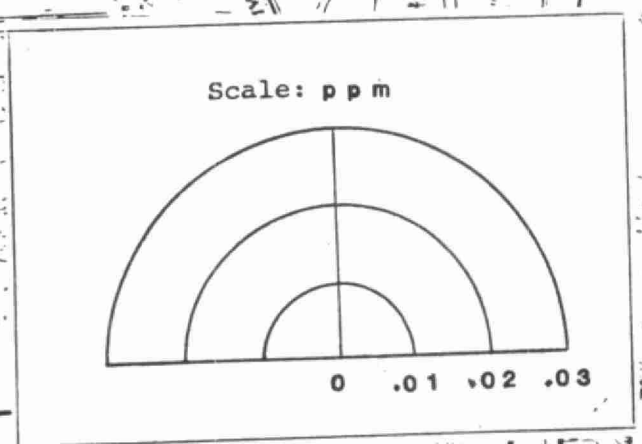
1:25,000

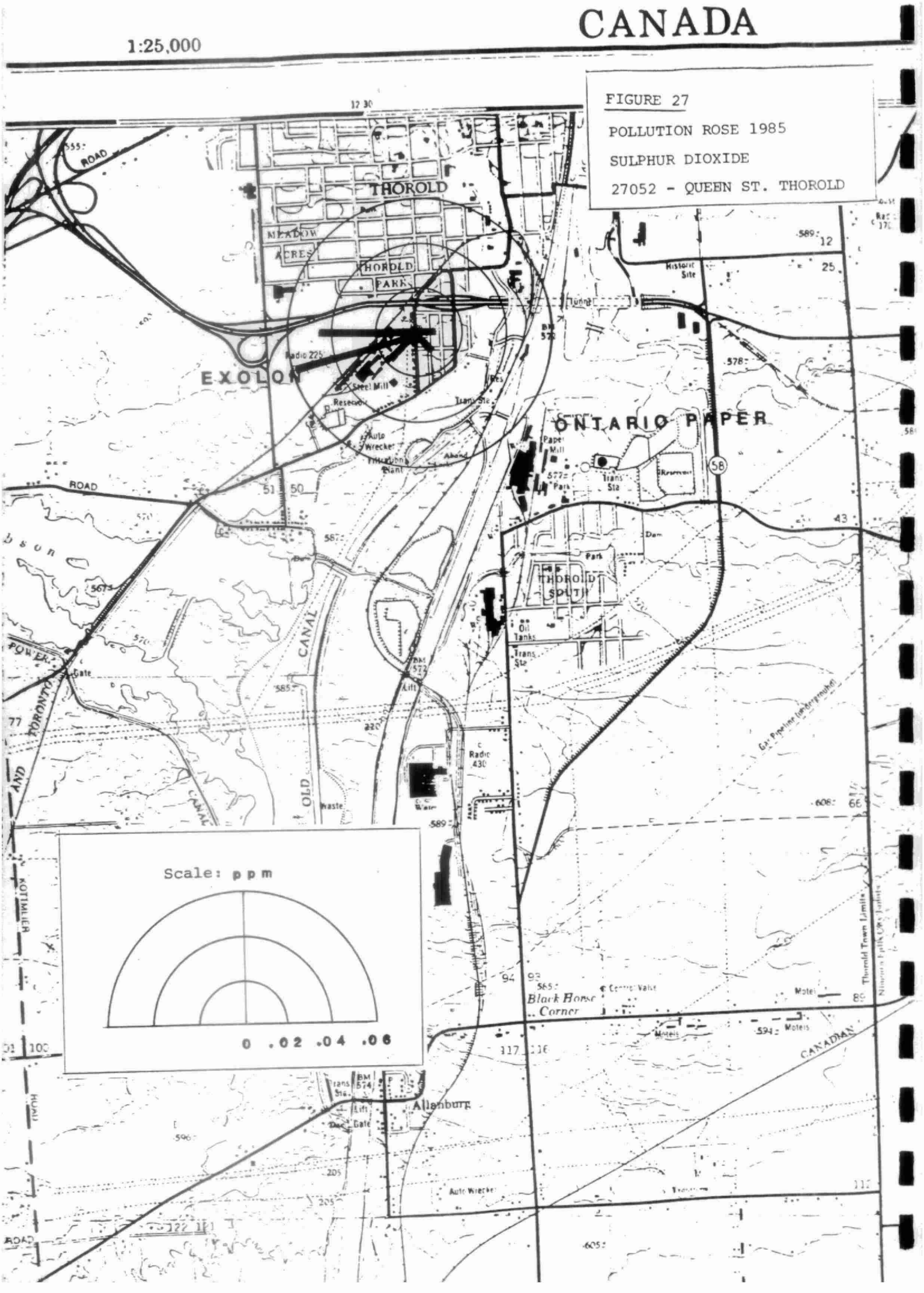
FIGURE 26

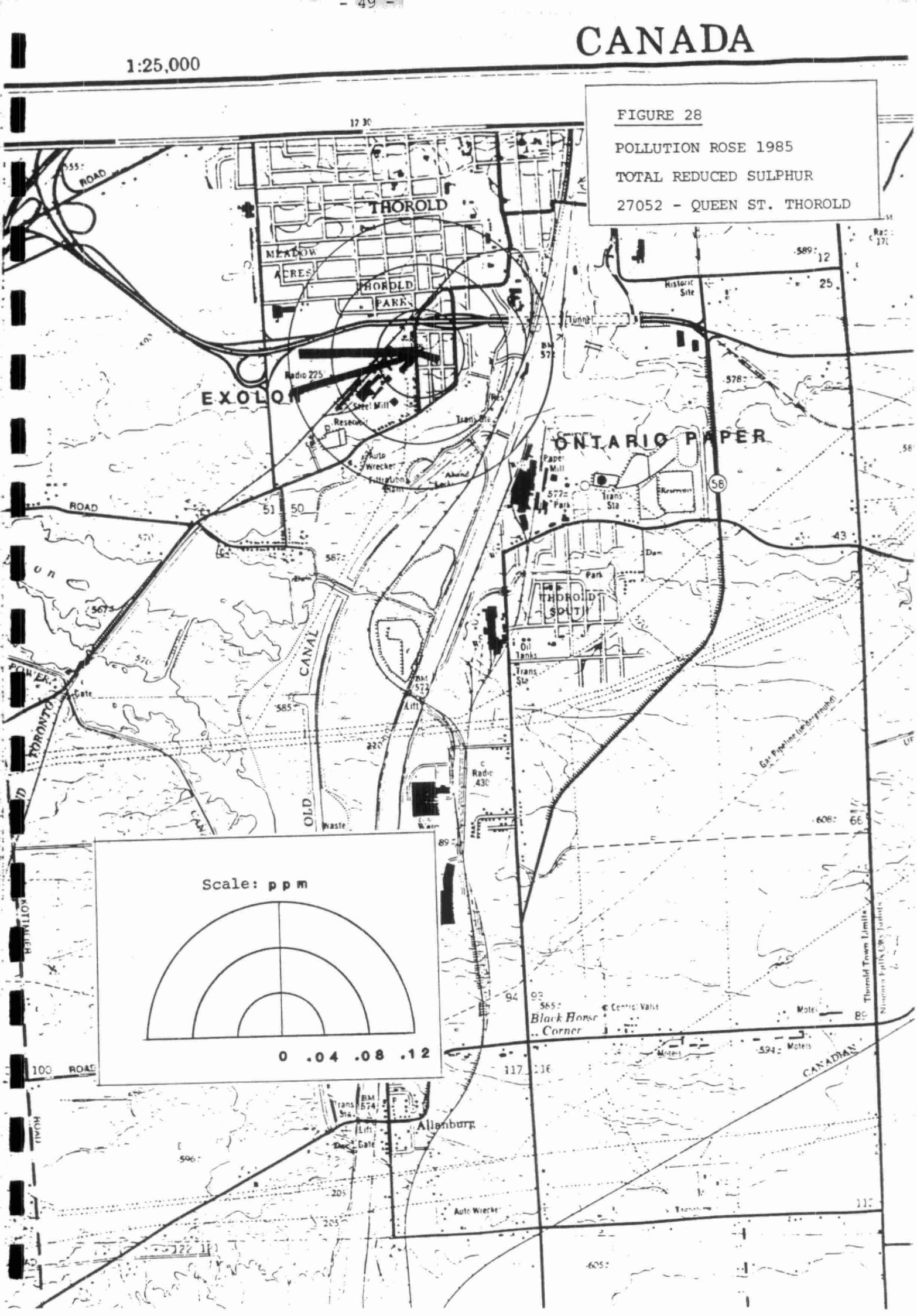
POLLUTION ROSE 1985

SULPHUR DIOXIDE

27042 - NIAGARA FALLS AVE./ONTARIO ST. THOROLD




CANADA
1:25,000
FIGURE 27
POLLUTION ROSE 1985
SULPHUR DIOXIDE
27052 - QUEEN ST. THOROLD
THOROLD
EXOLON
ONTARIO PAPER
Scale: ppm
0 .02 .04 .06
Allanburg
Black Horse Corner


CANADA
1:25,000
FIGURE 28
POLLUTION ROSE 1985
TOTAL REDUCED SULPHUR
27052 - QUEEN ST. THOROLD
THOROLD
MEADOW ACRES
THOROLD PARK
EXOLON
ONTARIO PAPER
THOROLD SOUTH
CANAL
OLD
Allenburg
Black Horse Corner
Scale: ppm
0 .04 .08 .12


CANADA
1:25,000
FIGURE 29
POLLUTION ROSE 1985
SOILING INDEX
27052 - QUEEN ST. THOROLD
THOROLD
MEADOW ACRES
THOROLD PARK
EXOLON
ONTARIO PAPER
THOROLD SOUTH
Scale: COHs / 1000ft
.0 .2 .4
Black Horse Corner
Allanburg
CANAL
OLD CANAL
ROAD
Historic Site
Tunnel
Trans Sta
Oil Tanks
Gas Pipeline (underground)
CANADIAN

TABLE 1
SULPHUR DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .25
24-Hour - .10
1-Year - .02

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1985) 1-Hour	24-Hour	SOURCE MONITORED
27048 Niagara Public Works - Fort Erie	.005	.005	.004[9]	.09	.03	0	0	Nanticoke Gen. Station
27056 Allendale Avenue Niagara Falls	.003	.004	.003	.07	.03	0	0	Ambient
27055 Stanley Street Niagara Falls	.003[5]	.002[5]	.006	.11	.03	0	0	General Abrasive Ltd.
27051 Norton/Portage Chippawa	.007	.007	.005	.09	.03	0	0	Norton Company
27037 North/Geneva St. Catharines	.005	.005	.006	.09	.04	0	0	General Ambient
27042 Niagara/Ontario Thorold	.023	.001	.005	1.39	.13	14	1	Ontario Paper Ltd.
27052 Queen Street Thorold	.016[5]	.011	.017	.58	.28	69	4	Exolon

9 - Numerical exponents refer to number of months sampled when less than 12

TABLE 2
TOTAL REDUCED SULPHUR
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 20 (Hydrogen Sulphide)

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	NO. OF HOURS ABOVE OBJECTIVE 1983	1984	1985	SOURCE MONITORED
27051 Norton/Portage Chippawa	0.2[4]	1.4[11]	2.1	57	4[4]	78[11]	71	Norton Co.
27052 Queen Street Thorold	5.8[5]	4.5	2.9	109	340[5]	567	376	Exolon
27055 Stanley Street Niagara Falls	0.8[5]	0.8	1.6	34	1[5]	4	10	General Abrasive Ltd.

4 - Numerical exponent refers to number of months sampled when less than 12.

TABLE 3
SOILING INDEX (COEFFICIENT OF HAZE)
UNIT - COH'S PER 1000 LINEAR FEET OF AIR

Ontario Objectives: 24-Hour - 1.0
1-Year - 0.5

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1984 MAXIMUM 24-Hour	NO. OF TIMES OVER 24-Hour OBJECTIVE (1984) 1983	1984	1985	SOURCE MONITORED
27056 Allendale Avenue Niagara Falls	.18	.22	.20	.8	0	0	0	Ambient
27037 North/Geneva St. Catharines	.27	.24	.26	.8	2	1	0	Ambient
27055 Stanley Street Niagara Falls	-	.38	.33	.9	-	1	0	General Abrasive Ltd.
27052 Queen Street	-	$.35^{11}$	.29	1.0	-	1	0	Exolon

11 - Numerical exponent refers to number of months sampled when less than 12.

TABLE 4
OZONE
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 80

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	NO. Of HOURS ABOVE OBJECTIVE 1983	1984	1985	SOURCE MONITORED
27037 North/Geneva St. Catharines	23.2	20.3	17.9	92	116	19	19	Ambient/Long Range Transport

TABLE 5
CARBON MONOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - 30
8-Hour - 13

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	24-Hour	NO. Of TIMES OVER OBJECTIVE (1985) 1-Hour	8-Hour	SOURCE MONITORED
27037 North/Geneva St. Catharines	0.4	0.4	0.2	15	3	0	0	Ambient

TABLE 6
NITROGEN DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .20
24-Hour - .10

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	24-Hour	NO. Of TIMES ABOVE OBJECTIVE (1985) 1-Hour	24-Hour	SOURCE MONITORED
27037 North/Geneva St. Catharines	.020	.018	.017	.08	.04	0	0	Ambient

TABLE 7

SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: 24-Hour - 120
1-Year Geo. Mean - 60

LOCATION	GEOMETRIC MEAN 1983	1984	1985	1985 MAXIMUM	% OF SAMPLES OVER 120 (1985)	SOURCE MONITORED
27056 Allendale Avenue Niagara Falls	50	48	44	154	3%	Ambient
27053 First/Bridge Niagara Falls	73	76	67	236	9%	Cyanamid
27055 Stanley Street Niagara Falls	68*	103	79	434	18%	General Abrasive Ltd.
27009 Norton/Portage Chippawa	69	73	64	189	9%	Norton Co.
27014 Stanley/Chippawa Chippawa	46	51	44	137	2%	Norton Co. Background
27030 Killaly/James Port Colborne	42	49	43	146	4%	INCO
27047 Davis/Fraser Port Colborne	51	57	49	291	4%	INCO
27037 North/Geneva St. Catharines	68	58	50	151	4%	Ambient
27052 Queen Street Thorold	115	131	106	434	39%	Exolon
27045 Alberta/Devon Welland	49	58	48	218	4%	Union Carbide

* - Composite of 2 locations - station moved closer to source in July 1983.

TABLE 8
CONSTITUENTS IN SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

NICKEL - Ontario Objectives: 24-Hour - 2.0

LOCATION	GEOMETRIC MEAN 1983	1984	1985	1985 MAXIMUM	% OF SAMPLES OVER 2.0 1983	1984	1985	SOURCE MONITORED
27030 Killaly/James Port Colborne	.057	.072	.034	0.5	0	0	0	INCO
27047 Davis/Fraser Port Colborne	.057	.071	.027	1.0	0	2%	0	INCO

ELEMENTAL CARBON - Ontario Objective: None

27045 Alberta/Devon Welland	4.3	4.7	3.3	11.9				Union Carbide

TOTAL CARBON - Ontario Objective: None

27045 Alberta/Devon Welland	11.0	10.4	8.8	30.3				Union Carbide

TABLE 9
DUSTFALL
UNIT - GRAMS/SQUARE METRE/30 DAYS

Ontario Objectives: 1-Month - 7.0
1-Year - 4.5

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Month	NO. Of MONTHS ABOVE OBJECTIVE 1983	1984	1985	SOURCE MONITORED
27005 Portage/Legion Chippawa	6.4[11]	7.8[11]	6.7[11]	10.0	3	5	5	Norton Co.
27006 Bridgewater/Oliver Chippawa	3.3	3.5	2.8	5.2	0	1	0	Norton Co. Background
27040 Plymouth Avenue St. Catharines	9.8	11.3	14.5	29.8	8	8	11	Aimco Foundry
27041 Glendale/QEW St. Catharines	6.2	6.3	8.2	11.3	4	2	9	G. M. Foundry
27054 Catherine/Russel St. Catharines	7.2[11]	8.0	6.4	11.5	4	4	4	Burnstein Foundry
27042 Niagara/Ontario Thorold	9.1	7.8	7.7	12.4	10	5	7	Ontario Paper
27043 McAdam Park Thorold	3.6	4.2[9]	3.9	7.1	0	2	1	Ontario Paper Background
27025 Harriet Street Welland	4.5[11]	4.9	4.8	8.6	0	1	1	Union Carbide
27026 Chaffey Street Welland	6.0[11]	6.0	4.9	7.7	1	2	2	Union Carbide
27035 Alberta Street Welland	8.8	10.2	7.4	12.1	8	8	5	Union Carbide

11 - Exponents refer to number of valid monthly samples when less than 12.

T

DATE	ISSUED TO
	Martin